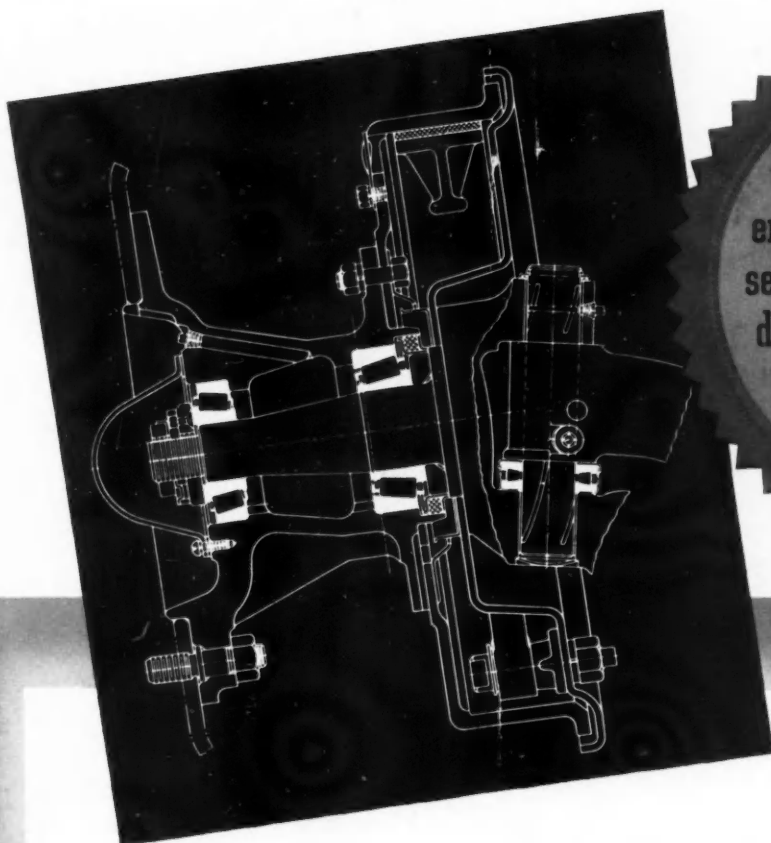


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OCTOBER 15, 1942



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keep 'em
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AUTOMOTIVE and Aviation INDUSTRIES

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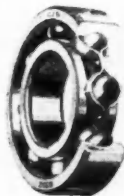
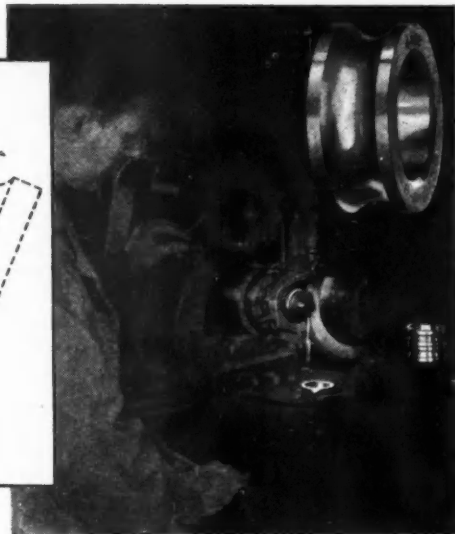
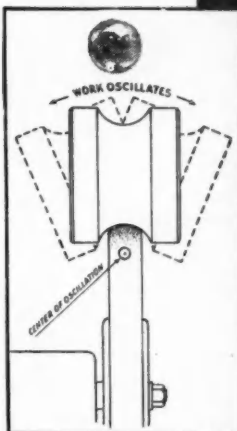
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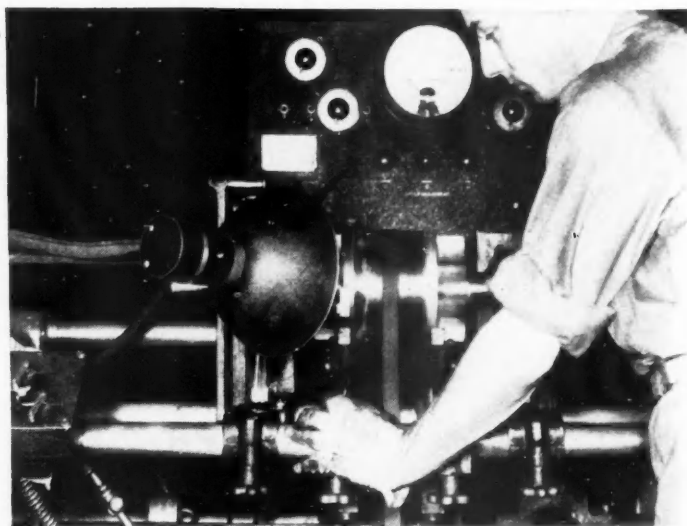
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AUTOMOTIVE and AVIATION INDUSTRIES

Volume 87 . . . October 15, 1942 . . . Number 8

**AUTOMOTIVE
INDUSTRIES**

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Air Line Traffic Up Seven Per Cent

Revenue passenger miles flown by United Air Lines in the first nine months of this year were approximately 7 percent above those for the corresponding period of 1941, it was disclosed in figures released by Harold Crary, vice president in charge of traffic.

With September estimated, United flew approximately 219,314,065 revenue passenger miles from January through September. This compared with 204,919,024 covered in the same period of last year.

September's estimated total was 28,401,200, or approximately the same as the 28,388,072 flown in August and 14 per cent under the 32,943,600 flown in September, 1941. This September decrease was attributable to the turning over of certain airplane equipment for military operations and the use of a larger percentage of the fleet's space for express, which is 152 per cent and mail, 67 percent, over a year ago, due to stimulated war-time traffic, Crary said.

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Get back of the Pay-Roll Savings Plan by encouraging employees to turn part of their earnings *regularly* into tanks and planes and guns through systematic purchase of

**U.S.
WAR BONDS**

The Scrap Drive

9

The whole country is scrap conscious now but just what it is accomplishing and what part the automotive industry is playing has not come to the front until now. Read this article and you may be surprised to find how far some of our outstanding companies are going to attain the objective.

SAE Engineers Analyze Aircraft Production

12

The SAE National Aircraft Production Meeting has just been held. Out of this meeting has come a whole lot of brand new data. It was their first meeting since Pearl Harbor so it was keyed to war production. Many new ideas presented.

Airplane Companies Pool Resources

15

The airplane producers of the east and west coasts have formed themselves councils for the pooling of their ideas, their facilities and talents. High positioned key men are in the list that make up these boards all dedicating themselves to more planes and better planes for the armed forces.

Boeing's Production Density System

16

As the Boeing organization was expanded to meet the greater production requirements of war they conceived a unique system. They felt that mechanized conveyor systems were not adequate for the large Flying Fortress bombers. The system that replaced it is most ingenious.

The BMW 801A Aircraft Engine

20

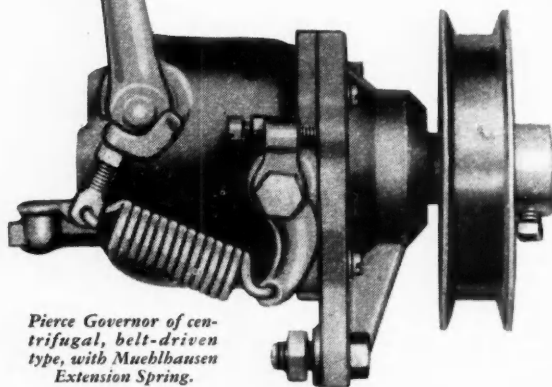
This is one of the latest powerplants introduced by the Germans. It has a number of unusual features. You will find this description interesting. It is enhanced by a number of illustrations.

The Houdry System for Producing Butadiene

30

Out of all the discussions of rubber substitutes will emerge something that will place us on top. Not the least of the elements in question is butadiene and its production. You owe it to yourself to keep posted. Here is an opportunity. The account is backed with the authority and knowledge of men with high batting averages in their league.

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- New Die Spring Bulletin illustrates, describes 206 sizes and types of die springs.
- New Armament Bulletin shows importance of springs for many types of war equipment.



The Scrap Drive

DECISION as to the final disposition to be made of tools, dies, jigs and machinery used to manufacture automobiles of the 1942 model and earlier models rests with the War Production Board. In the current intensive industrial salvage drive throughout the nation to collect 17-million tons of iron and steel scrap between July 1 and Dec. 31 in order to keep the steel mills operating through the coming winter, no Government

edict has required that all idle tools and machinery be relegated to scrap. The need for maintenance parts and the desirability of retaining some dies and machines for resumption of 1942 model production when the war is over are recognized by many as vital to preventing a breakdown of this country's motor trans-

portation system and to assure a quick return to peacetime normalcy.

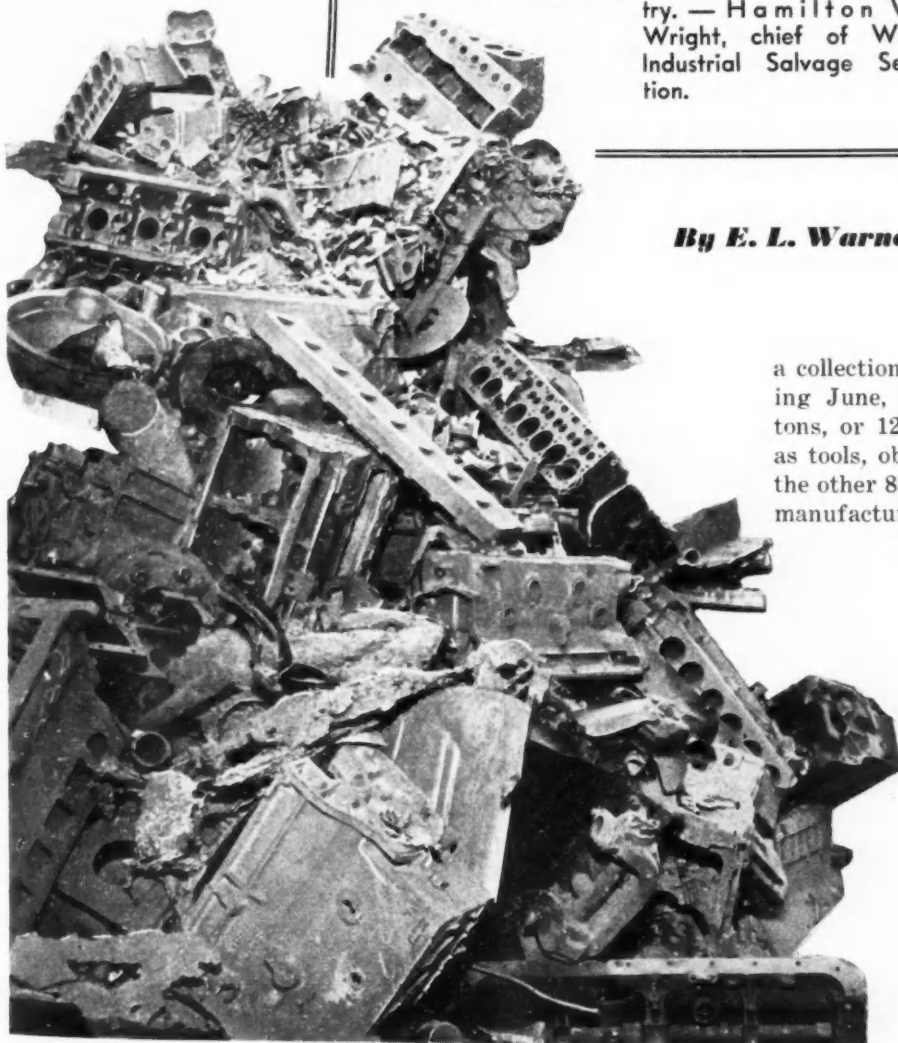
One of the first to put its drive on an industry-wide basis, the Automotive Council for War Production launched an intensive scrap collection program June 1 under which the member companies were urged to cooperate with the Salvage and Conservation Committee of the Council in expediting the flow of scrap to the mills. This resulted in

a collection of 337,000 tons of metal scrap during June, July and August, of which 40,000 tons, or 12 per cent, was dormant scrap, such as tools, obsolete machines and equipment, and the other 88 per cent was production scrap from manufacturing operations. Of the 337,000-ton total, 319,000 tons were iron and steel and 18,000 tons were aluminum, copper, lead, zinc and other non-ferrous metals.

At its recent Detroit scrap conference, the board of directors of the ACWP set forth a new and stronger statement of a broader policy objective on salvage by recommending to its members "the scrapping of all tools, dies and fixtures for the manufacture of replacement parts where demand indicates that such tools, dies and fixtures are no longer necessary for the maintenance of essential automotive transportation."

IT must be said that the Salvage and Conservation Committee of the Automotive Council for War Production has done an excellent job in obtaining scrap materials from the motor industry. — Hamilton W. Wright, chief of WPB Industrial Salvage Section.

By E. L. Warner, Jr.



George Romney, managing director of the ACWP, recently pointed out that approximately 85 per cent of the automotive industry's productive equipment already is working on materials essential to the war effort, while the remaining 15 per cent is listed and available to any other manufacturer of war products. Already more than 9000 pieces of manufacturing equipment from automotive plants have been transferred to other plants that could use it in the war effort. Many of the remaining special purpose machines provide an important source of parts to repair and provide replacements for equipment at work on war production. This is especially true now when most machinery is being used more intensively than usual, with many plants operating on a seven-day, 24-hr. basis. The amount of repair work consequently is increased and spare parts for machine tools are at a premium. "Cannibalization," or stripping parts from one machine to use on another, thus is a more prevalent practice than in peacetime.

"All automotive sources of the type of dormant scrap now being called for by the conservation and salvage authorities of the WPB are being minutely reviewed," said Romney, "and in every case where the protection of essential war transportation is not jeopardized, these facilities are going to the scrap pile."

The responsibility that rests with the automobile industry was aptly stated by P. O. Peterson, of Studebaker Corp., chairman of the ACWP Salvage and Conservation Committee, when he told the recent automotive scrap conference, "We are a big industry, and a big target—either for praise or blame. The automotive industry can be a big force for good in the American production picture by continuing to set the pace in the industrial salvage campaign. . . . The automobile industry IS different. It has a much harder job than the ordinary industry when it comes to picking out what is obsolete and what isn't. It's got maintenance problems for the customer in the field to consider and it's got post-war retooling problems to consider. . . . But unless we win this war there is little use to even think of any of the ordinary values, for they will not mean anything. So finally it comes down to this—the success or failure of our salvage campaign means the difference between survival and defeat."

The responsibility of formulating the Government policy as to what is scrap and what is re-useable material rests with the Materials Re-Distribution Branch of WPB. This branch is now engaged in a nation-wide inventory of all idle machinery, equipment and material with a view to defining what items are to be

retained and what are to be junked. The problem confronting automobile manufacturers and suppliers as to the disposition to be made of semi-fabricated or fabricated parts manufactured prior to the cessation of motor car production last February rests with the Materials Re-Distribution Branch. Where these materials are designated as scrap, it has been indicated by Government officials that some form of subsidy will be forthcoming in order to avoid impairment of any company's financial status. However, it is quite likely that companies may suffer a 15 to 50 per cent loss on the purchase price of such fabricated or semi-fabricated materials, not including any labor costs which the buyer may have put into the product.

Most automotive companies have appointed a single salvage authority who has power to render final decisions on what materials and equipment are to be re-

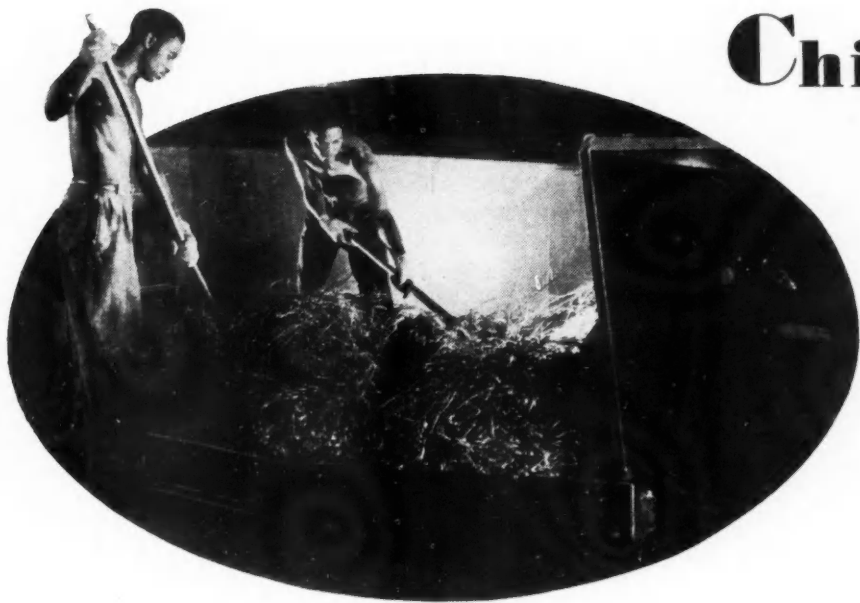
tained and what are to be scrapped. A complete record of equipment, dies, tools, machines and stocks is then set up, not only of material in the parent plant but in those of vendors as well. Replacement parts are checked to find out how many are in stock, what yearly requirements are and how long current stocks will last. Particular pieces of equipment also must be checked to find whether any are used for making similar parts for other models. One auto-

motive company has released for scrap 70 per cent of the items on the lists that were reviewed, and this will be increased through recent authorization to scrap frames, assembly fixtures, welding equipment, body carriers and other automobile manufacturing equipment. Another company checked all die storage areas so that no worthwhile source of material would be overlooked. Some companies have 1942 dies that have been obsoleted due to changes in parts design through use of alternate materials. Automotive suppliers, needing room for war expansion, have asked customers to release dies and other materials in the vendor's plants for salvage. Among the salvage items that have been turned up in the automobile industry are angle irons, window casements, chains, jacks, abandoned fire escapes, conveyor lines, rails and craneways, dollies and racks, welding jigs, hammer heads, furnaces, old storage bins, steel doors and floor panels, old stairways and foundry flasks.

In addition to providing vitally needed scrap, the drive has proved beneficial to automotive companies in other ways. It provides a cleaner and more efficient plant and reduces fire and accident hazards. Sale of the scrap actually pays cash dividends and some of the buildings and material scrapped actually may result in

(Turn to page 54, please)

FOR the benefit of those who may be unfamiliar with the mechanics of the Automotive Council for War Production, it should be emphasized once again that this organization was founded on democratic principles by men so strongly suspicious of dictatorial practices that they were willing to turn their backs on the most highly cherished traditions of their intensely competitive business in order to strengthen the Nation's hand in competition with the Axis.—George Romney, ACWP managing director, on scrap drive policy.



Metal turnings being pushed down to a crusher where they are broken into small pieces for easy handling.

A FAST chip-handling system that quickly turns vital metals back into the stream of war production has been developed at the new Ohio plant of the Wright Aeronautical Corp. now engaged in the line-production of Cyclone engines for numerous United States warplanes. In less than 40 minutes a pile of shavings can be removed from a machine into a special metal container, dumped into a conveyor train, crushed, freed of machining oil and compactly packed away in a railway gondola half a mile from the factory.

Under this new chip-handling system all excess metal is removed without interfering with production and each metal is segregated at the source. At each machine the excess metal is raked into a chip box which then is picked up by a lift truck and the shavings removed to a side-dump trailer car having a capacity of 35 cu. ft.

When a train of 10 to 15 heaping gondolas is collected on a roadway outside the plant, it is towed by a shuttle service powered by gasoline industrial



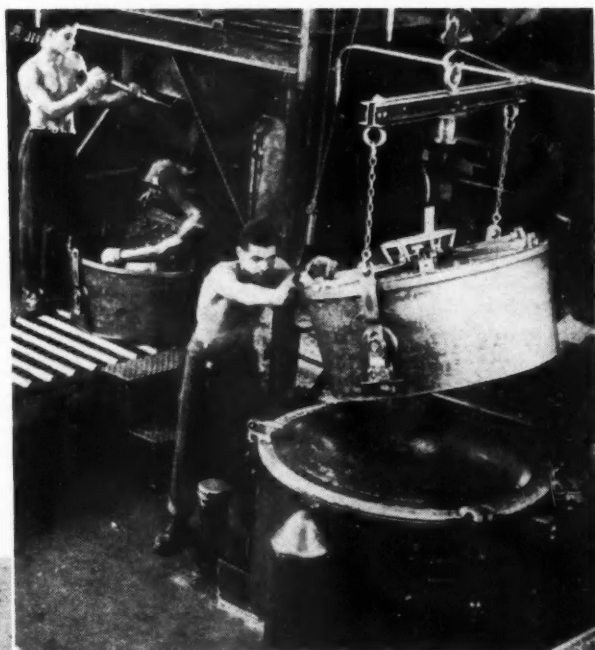
October 15, 1942

Chip Handling

System at Wright's New Ohio Plant

tractors to the chip processing plant. Here the side-dump gondolas toss their cargoes of metal into drain pans where a portion of the machining oil still clinging to the chips drains off. Then the bunches of chips or shavings are pulled apart enough to be stuffed into a hammer mill crusher which presses them into small pieces that can be handled easily and also shipped in a minimum of space. Chips, which have been cut with oil coolants, come from the crusher in a standard conveyor that dumps them in a standard industrial centrifuge.

(Turn to page 56, please)



Small pieces as they come from the crusher (rear), and one of the centrifuges (right) for removing the oil from them.

A conveyor train loaded with steel turnings on its way to the chip house at the Wright plant in Ohio.

SAE Engineers Analyze Aircraft

MANTLED by war time restrictions, the first SAE National Aircraft Production Meeting since Pearl Harbor was held early this month in Los Angeles. The members were confronted with the novel experience of doing without preprints, of having to forego their anticipated floor discussion, and of restricting their activities, in the main, to listening to the speakers and to viewing the 22 exhibits at the aircraft engineering display.

The Government had requested that all in attendance avoid discussions either formal or informal of any subjects which might be of value to our enemies.

It was the largest SAE Pacific Coast meeting, with 1500 registrants, including some of the top ranking aviation production and engineering men in the country. President A. W. Herrington announced the phenomenal growth of the Society of Automotive Engineers in the aircraft industry, with 46 per cent of its membership now engaged in aircraft work.

Balanced armed might, not concentration of any one arm is going to win the war. The prowess of America's air arm is proved by the box score, with mastery of the air "wherever we have American equipment and American pilots" who are knocking down enemy planes in a ratio of 4 to 1 for every American plane lost. In the postwar era the aircraft industry will keep rolling at high speed in the world wide race of "national rehabilitation through fast transport." These opinions were expressed at the general session, under the chairmanship of SAE Past Presi-

dent A. T. Colwell and by Col. J. H. Jouett, Aeronautical Chamber of Commerce of America president, who assured his audience that the nation's air production program is coming along so well that the President's goal of 60,000 planes is being approached.

The major war problem is now supply rather than production, according to Thomas Wolfe, Western Airlines, who spoke for the Air Transport Association of America. "We must deliver the goods, and quickly. The average daily cargo carried by domestic airlines during the year prior to Pearl Harbor was 60,000 lb. But so tremendous has been the growth of this field under war conditions that the cargo capacity of domestic carriers will be approximately 3,000,000 lb per day by Jan. 1."

In spite of this 5000 per cent increase, Mr. Wolfe said that we are still fighting a 400 mph war with a 10 mph supply line. "What we need," he declared, "is a rapid production of available types of transport planes now. The spotlight on huge transport ships is too far ahead at this time."

We are learning a new air geography, according to Mr. Wolfe, for "new trade routes are being established, old seaports are going out, the trend is away from harbors, and many seaport cities will be by-passed by air cargo routes."

The lowly greaseball of the American Volunteer Group in Burma and China had his hour in the sun when Tye M. Lett, Jr., overseas representative of the Allison Division of General Motors, who was with the



Production Problems

National Aircraft Production Meeting at Los Angeles Attracts 1500 Experts; Technical Sessions Held under Censorship Restrictions

AVG for one year, spoke on "Ground Crewing the Flying Tigers," and related how the men skillfully "cannibalized" grounded planes to keep others in the air. "Bits and pieces of five grounded Curtiss P-40's practically overnight became three fighting P-40's. That miracle confounded the Japs." He compared the combat qualities of the P-40 and the Zero. The Zeros had greater maneuverability and rate of climb than the early P-40's, but the latter had protection which the former lacked, and were superior in "the most important pursuit combat category—speed upwards of 400 mph."

President Herrington, who recently returned from India, Burma, and China, gave the principal address of the general session. Describing the enormous responsibility resting upon the engineers of the country both in a world at war and in a world at peace, he praised the standardization work of the SAE over the past 37 years. "Those of us who have had the opportunity to examine the engineering practices of other countries, particularly Germany and Japan, are now fully aware of the terrible price they are paying for their failure to take more cooperative steps in standardization work." Standardization is the recognized foundation upon which our great automotive industry has been successfully built, and in all phases of automotive work, particularly in the aircraft field, it has contributed an essential factor in making possible the unheard expansion of production which has taken place.

What about the postwar world? What will we do with this tremendous aircraft producing industry we have created? Mr. Herrington answered by pointing out that the United States is a large nation geographically, and that we will therefore develop a civil air transport system the size and extent of which will surpass the dream of our wildest visionaries of today. And, because we are the only nation capable of bearing the economic load of such a burden, we will be forced to maintain a military air fleet capable of going anywhere at any time to aid as a part of an international police force to preserve order. The safety of our homes and our lives will rest squarely upon the shoulders of our aircraft designers and producers, he emphasized.

Almost everybody in attendance made it a point to view and study the parts of the Mitsubishi Kinsei engine and of the Junkers 211B engine which were displayed during the meeting. Interesting motion pictures were shown by Wright, North American

Aviation, Hamilton Standard Propeller, and Rohm and Haas.

R. N. DuBois, chairman of a morning session, and chief test engineer, Aircraft Engine Div., Packard Motor Co., read a paper by James E. Ellor, British Air Commission, "Pressure Cooling," which pointed out the advantage of pressure cooling, using glycol-water mixtures versus straight glycol.

Beginning with a review of the development of carburetor air filter installations in aircraft power plants prior to the war, W. D. Cannon, field engineer, Wright Aeronautical Corp., in his paper, "Requirements for Carburetor Air Filters for Aircraft Engines," analyzed new problems which have led to a reappraisal of filter requirements. He discussed some of the German, British, and American installations. A description of an improvised air-scoop and filter was given to emphasize the fact that the installation design of the carburetor air-filters was properly the responsibility of the aircraft manufacturer. Mr. Cannon presented current design requirements for carburetor air filters with several diagrammatic sketches of typical installations. A number of ways of effectively reducing these requirements to practice without adding to the responsibilities or duties of the pilot were illustrated.

The Flight Testing Session was conducted by C. L. Johnson, chief research engineer, Lockheed Aircraft. Flight testing today is nearly an exact science, according to Warren T. Dickinson, flight test engineer, Douglas Aircraft Corp., who flight-tested Douglas' B-19, the world's largest airplane. In his paper, "Flight Testing Equipment for Large Aircraft," he reported that it took flight equipment weighing 10,804 lb and valued at \$38,600 to test the giant four-motored Douglas cargo plane C-54 last winter, and more than 26,000 ft of motion picture film were exposed in recording performance and other data. Automatic instruments supplanted a flight crew of 22 men otherwise necessary to record dial readings manually.

The greatest single improvement in flight test equipment in years is the electronic potentiometer developed by Douglas engineers for automatic temperature recordings, Mr. Dickinson said. Through miles of electrical wiring and thermocouples located remotely

By R. Raymond Kay

throughout the plane structure some 264 temperature readings were collected on the Douglas C-54 in a continuous permanent record.

"Intercoolers and Their Performance in Aircraft," was the subject of a paper presented by P. A. Scherer and S. K. Anderson, of Airesearch Mfg. Co. Mr. Scherer, research engineer, read the paper, the theme of which was that as the weight of the intercooler is reduced to gain dimensions, power reductions also can be achieved, and that this results in a lighter take-off weight for the airplane.

Airframe-production technique was the all-important subject of an afternoon session under the chairmanship of J. L. Atwood, executive vice-president, North American Aircraft. "Technical Developments in High Production Sheet Metal Forming" was the topic of an interesting paper presented by W. Schroeder and T. H. Hazlett, research engineers at Lockheed Aircraft Corp. Mr. Schroeder read the paper which discussed recent developments in the application of technical knowledge and engineering methods to the problems of designing and forming sheet metal parts. The basic forming procedures were described and the quantitative limits of each were given. He pointed out the types of equipment suitable for the various classes of forming.

Phil Koenig, of Consolidated Aircraft Corp., read his paper, "Impact Extrusions and Cold Pressing of Aluminum Alloy Airplane Parts." The steel dies are hardened as much as possible and often chromium-plated on the wearing surfaces. A pressure of 160,000 to 180,000 psi is necessary to force the metal into the cavities of the dies. Many advantages of this technique were described. It allows close tolerances and actually improves the structure of the metal through an increase in density. It also is a very fast process, requires relatively inexpensive dies, and releases milling machines and turret lathes for other work.

"How Vultee Uses Master Layout in Production" was a paper given by S. R. Carpenter, supervisor of engineering, Vultee Aircraft. He discussed the method of making original master layouts, the manner of reproducing them for template and tool uses, and the application of the master layout by tooling and template for the development of tooling of production.

Direct comparison of the Mitsubishi Kinsei engine with present American air-cooled radial engines was made by W. G. Ovens, Wright Aeronautical Corp. He said that the Japanese were not behind in production methods of their modern aircraft engines, and pointed out the similarity of the Mitsubishi Kinsei engine to

(Turn to page 56, please)

SAE Nominees for 1943

President

Mac Short, vice president of engineering, Vega Aircraft Corp.

Treasurer

David Beecroft, Bendix Products Division, Bendix Aviation Corp.

Vice Presidents

Aircraft: John G. Lee, assistant director of research, United Aircraft Corp., Research Division.

Aircraft Engine: S. K. Hoffman, chief engineer, Aviation Corp., Lycoming Division.

Diesel Engine: Grover C. Wilson, fuel research engineer, Research and Development Laboratories, Universal Oil Products Co.

Fuel and Lubricants: W. M. Holaday, automotive research engineer, Socony-Vacuum Oil Co.

Passenger Car: R. E. Cole, vice president of engineering, Studebaker Corp.

Passenger Car Body: G. J. Monfort, engineer, Body Division, Chrysler Corp.

Production: Arnold Lenz, assistant manufacturing manager, Chevrolet Motor Division, General Motors.

Tractor and Industrial: C. G. Krieger, agricultural engineer, Ethyl Gasoline Corp.

Transportation and Maintenance: A. M. Wolf, automotive consultant.

Truck and Bus: E. W. Allen, coach engineer, General Motors Truck and Coach Division of Yellow Truck and Coach Mfg. Co.

SAE Council, Term 1943-44

N. P. Petersen, president, Canadian Acme Screw & Gear, Ltd.; C. G. A. Rosen, director of research, Caterpillar Tractor Co.; J. C. Zeder, chief engineer, Chrysler Corp. Continuing on the Council for 1943 will be the following men who

were elected for a two-year term at the beginning of 1942: W. S. James, chief engineer, Studebaker Corp.; J. V. Savage, superintendent, City of Portland, Municipal Shops & M. V. Inspection Station; T. P. Wright, assistant chief, Aircraft Sec-

tion, War Production Board. Serving on the 1943 Council as Past Presidents will be A. W. Herrington, chairman, Marmon-Herrington Co., Inc.; and A. T. Colwell, vice president, Thompson Aircraft Products Co.



First East Coast Council Meeting: Seated left to right: Glenn L. Martin, G. W. Vaughan, Victor Emanuel. Standing left to right: O. L. Woodson (Bell), R. S. Damon, J. Carlton Ward, Jr., L. C. Goad and George Chapline (Brewster).

Airplane Companies Pool Resources

EASTERN and western airplane manufacturers have formed two separate organizations, but the difference is mostly geographical as both are associates in a common wartime objective—the pooling of their engineering and manufacturing resources to achieve maximum production of warplanes. Each is composed of eight companies, the eastern organization being called the Aircraft War Production Council, East Coast, Inc., and the western organization the Aircraft War Production Council, Inc.

Representatives of the eastern manufacturers met Oct. 2 in New York City for the first meeting and elected officers. Guy W. Vaughan, president of Curtiss-Wright Corp.,

was named president; Glenn L. Martin, president of Glenn L. Martin Co., vice-president; and J. M. Scanlan, assistant secretary of Curtiss-Wright Corp., secretary and treasurer. Other members of the board, which will meet monthly, consist of Victor Emanuel, Aviation Corp.; L. D. Bell, Bell Aircraft Corp.; C. A. Van Dusen, Brewster Aeronautical Corp.; L. C. Goad, Eastern Aircraft Division of the General Motors Corp.; J. Carlton Ward, Jr., Fairchild Engine & Airplane Co.; Ralph S. Damon, Republic Aviation Corp. Officers are to be changed every three months with the vice-president automatically succeeding

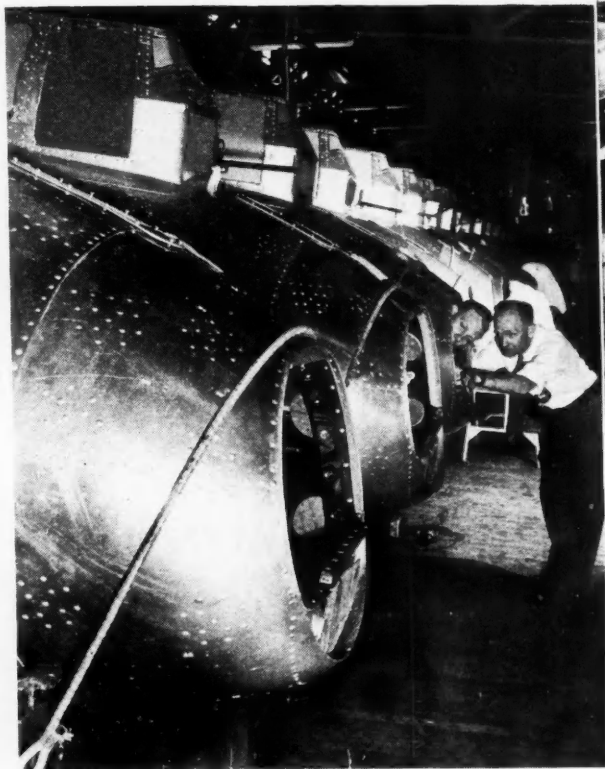
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West Coast Board Meeting: Left to right: John Canaday (Vega), Cyril Chappallet (Lockheed), John Northrop (Northrop), Ted Sullivan (Vultee), J. H. Kindelberger, Robert E. Gross, Harry Woodhead, Donald W. Douglas, LaMotte T. Cohu, Courtlandt Gross, Glenn L. Martin, T. Claude Ryan, A. M. Rochlen (Douglas), Joe Sherman (Consolidated).

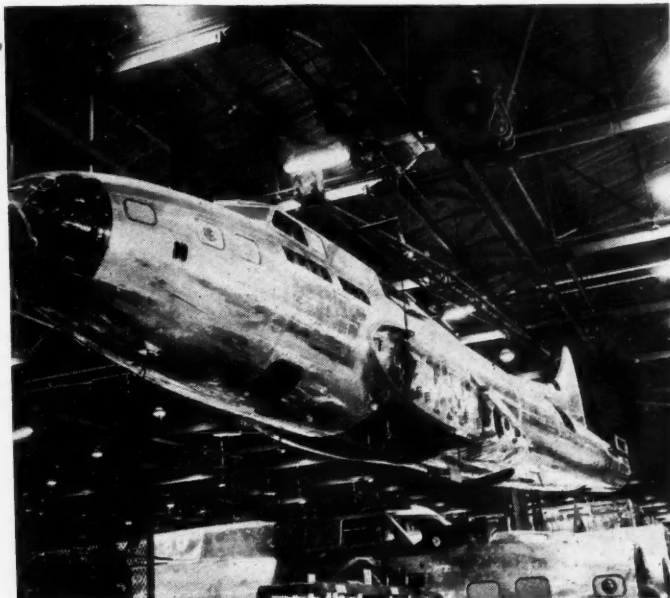
(Right) Fuselage front half sections for Flying Fortresses.

(Below) Tail "stinger" turrets before going to the final assembly floor. Each will bristle two guns.



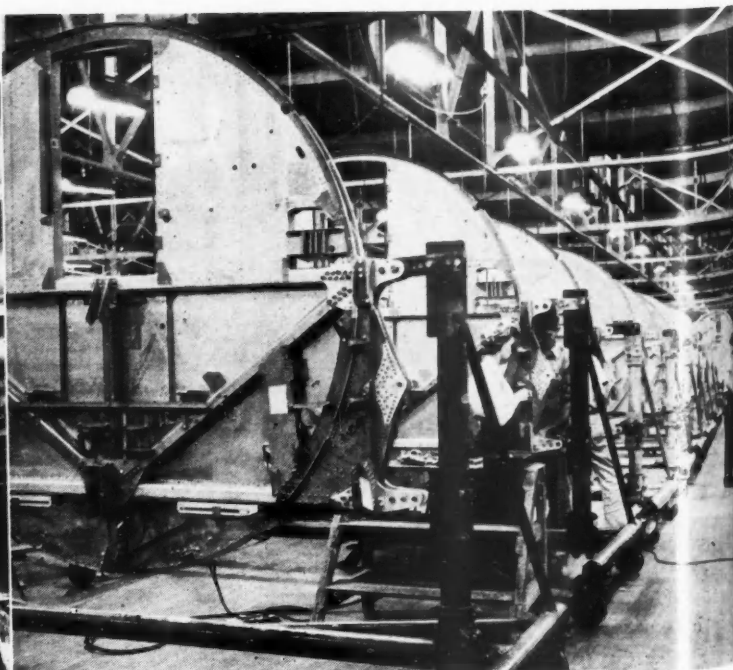
(Below at right) Sub-assemblies for fuselage front half sections.

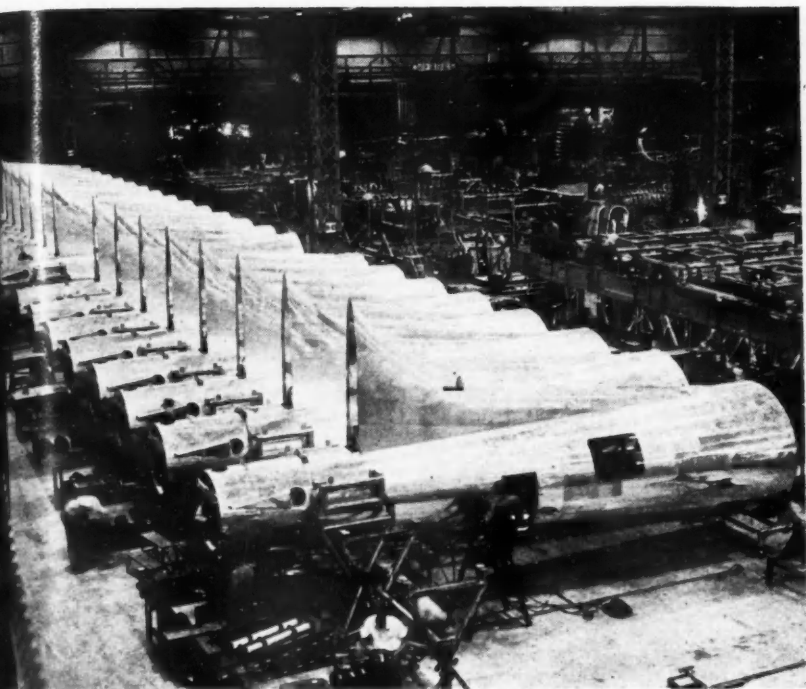
(Below) Fuselage assembly of the front and rear sections on its way to the final assembly fixture, where wings, tail surfaces and other parts are added to complete the plane.



Boeing's

TWO years ago when the aircraft business was expanding rapidly, Boeing officials came to the conclusion that the mechanized conveyor system was not suited ideally to the building of large four-engined warplanes such as Flying Fortress bombers. The reasons which lay behind their conclusions were logical ones. An aircraft, in its final form, is extremely extravagant of factory space and a fighting ship for best results cannot be built in a frozen pattern. The produc-





Fuselage rear half sections. Constructed as complete units, with all major interior fitting installed, both front half and rear half sections of a fuselage are moved by crane from their respective jigs to lines of fuselage final assembly jigs.

found to be suited particularly to the building of aircraft under present conditions. Acknowledgment of the production density system's merit was made recently when the Boeing Aircraft Co. was presented the aircraft industry's first joint Army and Navy production award. Boeing has turned out Flying Fortresses consistently on schedule or ahead of it, and has tripled its production rate since Dec. 7. Its output in pounds of aircraft per square foot is understood to rank first in the industry. When, some months ago, Boeing changed over from the production of B-17E to the new model B-17F, incorporating more than 400 design changes or approximately 20 per cent new ships, there was no stoppage or slow down of production.

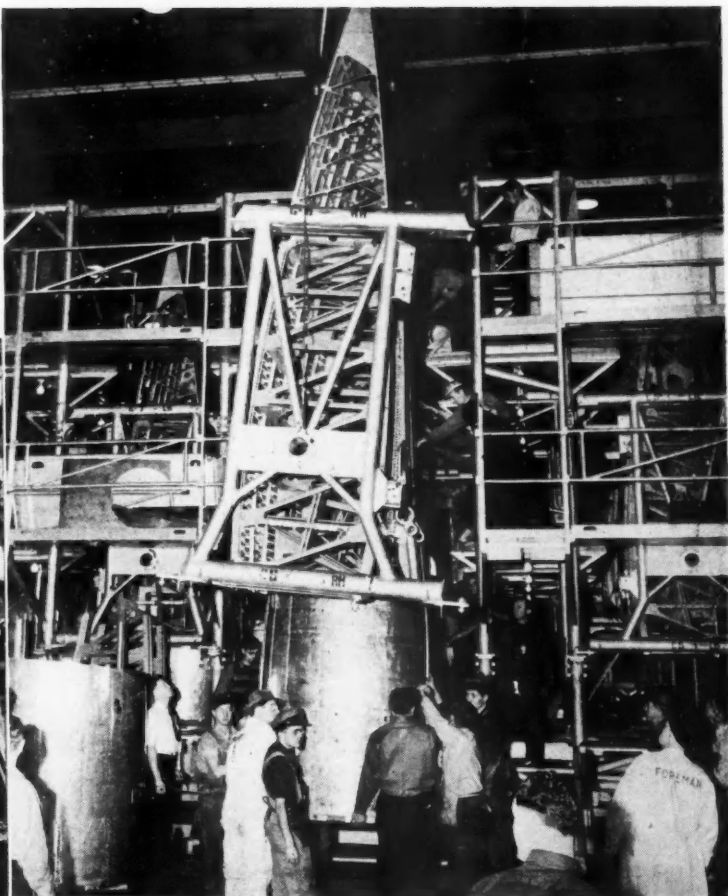
Production Density System

tion system therefore should make the most efficient use of manufacturing facilities and also should incorporate the acme of flexibility.

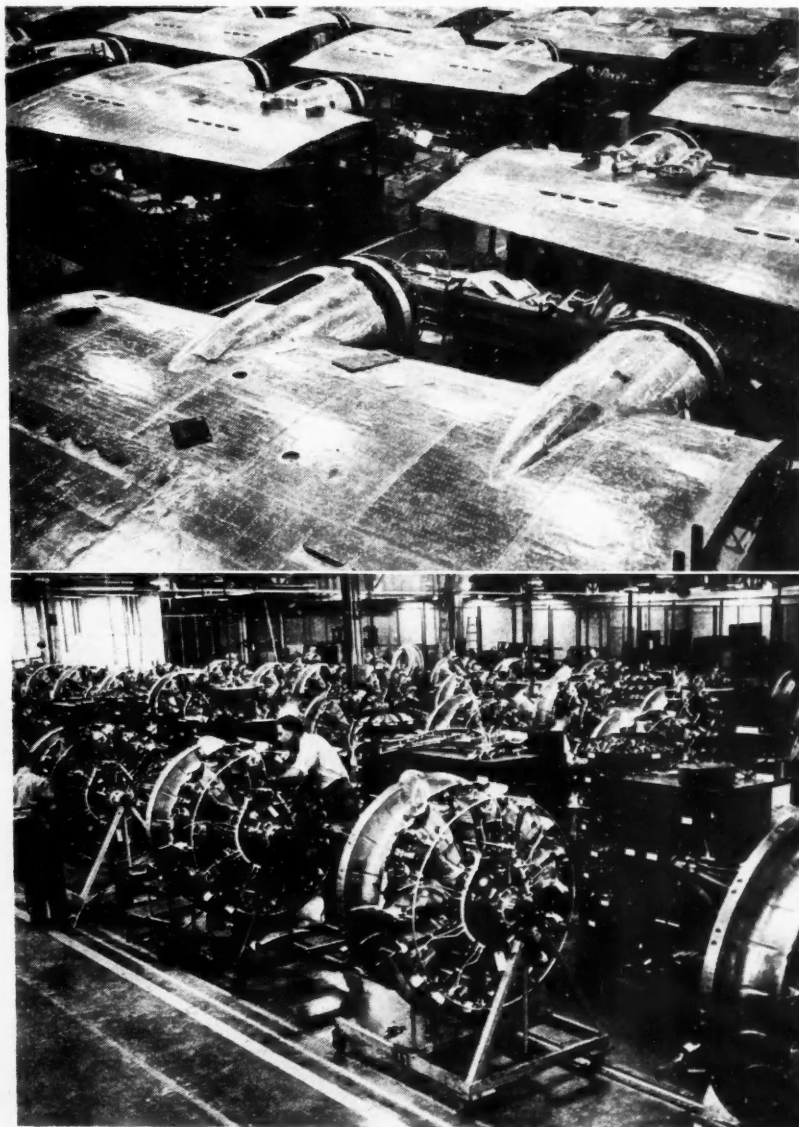
Boeing's production system, which is called "production density," portrays a radical departure from past conceptions of quantity production, and while of little value in building automobiles or refrigerators, it has been

Batteries of three-story jigs, perpendicular to the floor and large enough to accommodate large crews of workers, are used to build wings. Overhead cranes lift them out of the jigs. Adjustments permit Boeing inspectors to check the accuracy of the jigs to tolerances of .0005 in.

(Below) A sub-assembly department where leading edges for Flying Fortress wings are made in sections.



Wings, after being removed from the wing jigs, are placed on the wing lines, where the engines, control cables, leading edges, and many other important installations are made. When the wing leaves this line, it is a complete unit, and need only to be attached to the fuselage, and connected to make a completed aircraft.



(Above) Engines for the Boeing Flying Fortresses follow their own production lines. Engine mounts, and many other necessary additions are attached here, before the motors are fastened on the wings, on the wing line.

(Right) Flying Fortresses nearing completion in final assembly fixtures where the major segments of fuselage, wings and tail surfaces are joined together; control cables, tubes and wires are connected, fairings are put on, and the bomber is ready to roll out of the plant.

The first stoppage of the F's was test flown on the day the final E bomber was delivered to the Army Air Forces.

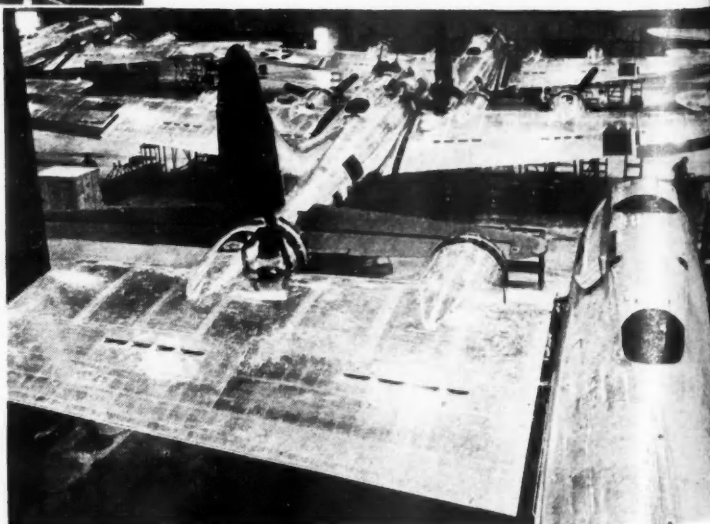
Boeing's type of production system means making the best possible use of available floor space. Instead of one elongated final assembly line, Boeing uses several lines each of which builds a portion of the plane. By breaking the plane into distinct

divisions, each of which is completed, the production lines can be compacted into considerably less space than would be required for an elongated assembly line on which the aircraft would be assembled into its final form at the earliest possible time. Boeing retards final assembly until the last possible moment, and final assembly of the Flying Fortress is merely the joining together of the several completed sections of the ship.

In effect, Boeing has no final assembly line, but rather a final assembly fixture, a station where complete major sections are joined, and wires and tubes are connected. There are two positions for final inspection. By accomplishing installations within the major parts or assemblies of the plane previous to final assembly, very little of the factory space is used by a completed aircraft.

Boeing's system of production is both original and simple, but its very simplicity manifests the tremendous amount of original and organizational thinking that went into the laying out of production facilities. An aircraft of any kind, complete with wings, occupies a considerable amount of space. A Boeing B-17 bomber has a wing spread of more than 104 ft and a body of over 70 ft.

Manufacturing the Flying Fortress is divided into seven distinct major assembly operations: body



minors, or the assembling of the skeleton of the forward part of the fuselage; fuselage nose section, or the front half of the fuselage; fuselage tail section, or rear half of fuselage; the tail turret, that portion of the fuselage aft of the dorsal fin; fuselage final assembly, where the three parts of the fuselage are put together into a complete aircraft body; wing structures, where the wings are built in sections; and wing installations, where the engines, gas tanks and other items are installed on the wings.

For these major assemblies Boeing uses several long but compact production lines in which each major component part of the plane is virtually completed before final assembly begins. Fuselage final assembly, wing installation, and tail surfaces, the latter being sub-contracted, feed into the final assembly fixture, where the aircraft is finished.

To keep this type of production from becoming bottlenecked, Boeing instituted simultaneously an extensive sub-assembly procedure. Sub-assembly at Boeing is defined as the joining together of two or more, and usually more, parts into a portion of an assembly. Sub-assemblies feed into major assemblies, thus maintaining a smooth even flow of material through the various stages of manufacturing.

The length of travel of raw materials through to the finished aircraft at the Boeing plant is said to be considerably shorter than in other comparable plants. The materials used in manufacturing enter the plant through a single channel. They progress into the fabri-

cating section of the plant where parts are manufactured on giant hydro-presses, small punch presses, draw and form dies, welding machines, and many others. With the increased demand for Flying Fortresses, Boeing installed millions of dollars worth of heavy manufacturing machinery to aid in fabrication. The completed parts go to sub-assembly, which feeds major assembly, then into final assembly. Mechanized carloaders are utilized to transport parts and overhead cranes for moving major assembly sections.

Boeing's density system of production is a fluid one enabling the rapid adoption of design changes. A superior war plane cannot be built in one frozen pattern. As this nation develops a superior weapon, the enemy eventually finds a vulnerable spot, or a means of combating it. This requires a change sometimes of a minor nature, sometimes a major design feature. From the lessons learned in actual combat, the Army makes requests for changes which must be incorporated rapidly into planes being produced. Because of the flexi-

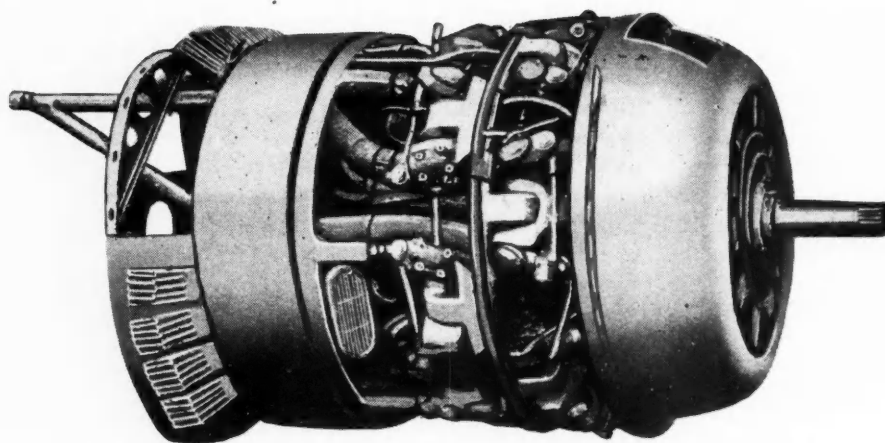
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(Below) One of the giant hydro-presses in Boeing's fabrication department.

(Right) One of the final touches to a Flying Fortress in the final assembly jig—connecting the control wires to the rudder.

(Below) Spot welding is concentrated in one section of the Boeing plant.





Side view of a complete unit taken from a Dornier 217 bomber. One of the blower intakes is on the lower left. The internal air scoop is attached to the cowling. A panel removed from the nose gives access to the magneto.

ONE of the latest engines to be introduced by the Germans in their military planes the BMW 801A, has attracted considerable attention on account of its advanced features of design. This engine now powers at least three types of military aircraft the Focke-Wulf FW 190 fighter, the Focke-Wulf 200 K2 bomber, and the Dornier Do 217E bomber. It is a product of the Bayerische Motoren Werke, of Munich, one of the pioneers in the German aircraft-engine industry, which during World War I developed the so-called "super-dimensioned" engine in which high fuel economy was achieved by using a high compression ratio and preventing detonation at ground level and low altitudes by throttling or choking. About ten years ago the firm acquired from the Pratt & Whitney Aircraft Co. a license to manufacture P-W aircraft engines in Germany, and the new engine in its basic features is closely related to the Pratt & Whitney Twin Wasp. What makes it outstanding is the masterly arrangement of sub-assemblies and accessories, which results in a well-streamlined power unit of minimum cross-sectional area for the power rating.

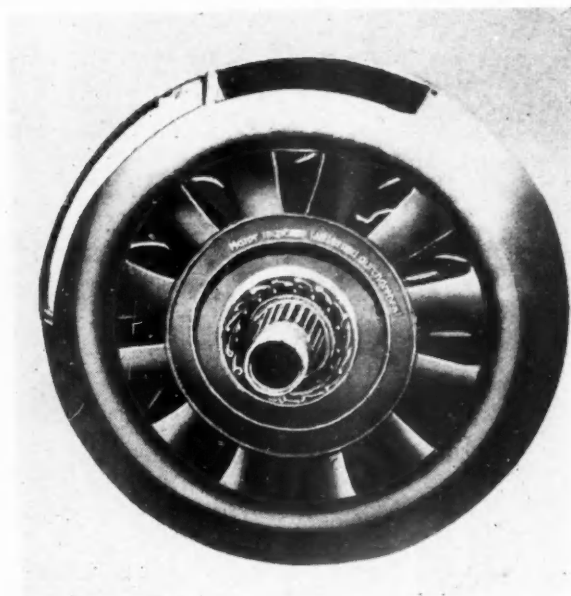
Considerable information on the new engine has come to hand from British sources. A translation of a descriptive article which appeared in the German aviation periodical *Flugsport* has been made available by the British Ministry of Aircraft Production, which also issued several reports on the Dornier Do 217E-1 bomber, equipped with this engine. Besides, a two-installment article by F. C. Sheffield, based on a story of the BMW engine from a Dornier 217 bomber which crashed in England, appeared in recent issues of *Flight*, and the following descriptive details and comments are based on these sources. The German description in *Flugsport* naturally was written chiefly for the benefit of operators and service personnel, while the British publications, no doubt, are intended mainly for engineers and technicians, so the subject has been dealt with from every angle. For the illustrations reproduced herewith we are indebted to *Flight*.

The BMW 801A is a 14-cylinder, two-row radial,

air-cooled engine with fuel injection. Its cylinder bore and piston stroke are 6.15 in. each, which makes its piston displacement 2557 cu. in. The complete powerplant is enclosed in a cowling of 52 in. diameter and 58 in. length. This cowling is a body of revolution, suitably faired at the front, except for slight pro-

tuberances on opposite sides which enclose air scoops for the blower. The take-off (3 min.) rating of the engine is 1580 hp, and the continuous rating 1460 hp at 16,300 ft.

The comparatively small overall diameter of 52 in. for an engine output of the order of 1500 hp is made possible by using a stroke no greater than the bore, and by making the cowling hug the cylinder heads closely all around. The cowling consists essentially of three parts, viz., the front hood which is provided with a sliding ring by means of which the flow of air through the oil cooler can be regulated; the rear hood, with a sliding ring for the control of the engine-cooling air, and the center cowl. The latter is provided with two pairs of flaps, two upper and two lower, which can be opened for inspection and service operations and held in the open position by struts.



Front view showing the fan which is driven at 1.72 times crankshaft speed. It supplies all air for the engine, cylinder cooling, oil cooling, and cabin and wing heating.

BMW 801A Aircraft Engine

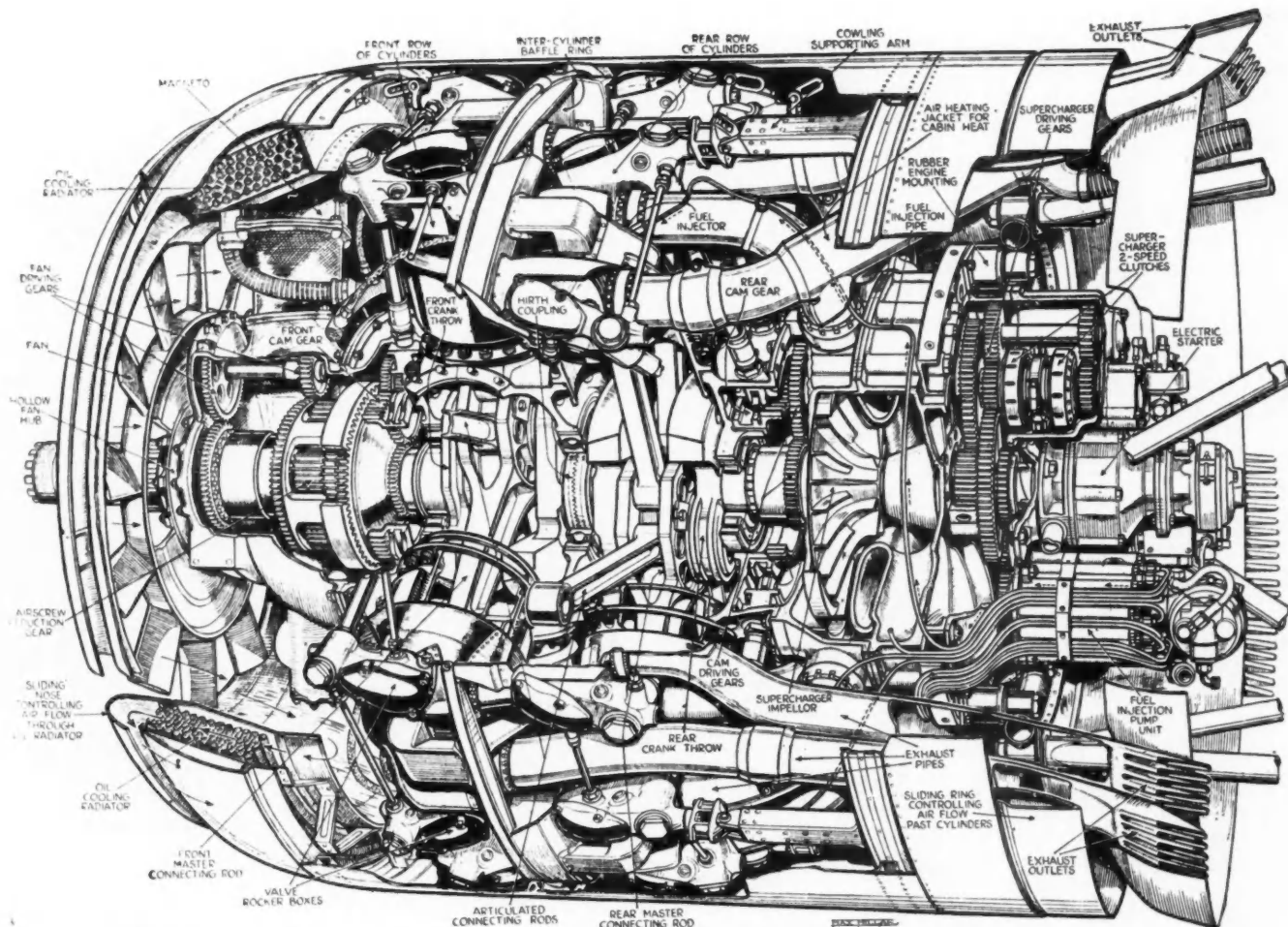
For more extensive operations on the engine the cowling can be removed completely. The various sections of the cowling are carried on three rings which in turn are supported from the valve-rocker housings by means of rubber-bushed bolts. The intermediate one of these rings also supports the inter-cylinder baffle plates.

What may be called the engine structure consists of six parts, namely, the crankcase, reduction-gear case, blower case, air-intake case, auxiliary-gear case, and oil sump. The crankcase is made up of three steel castings, the division planes containing the axes of the two rows of cylinders. These parts are held together by means of tension bolts located between cylinder openings.

The crankshaft is of the built-up type and is sup-

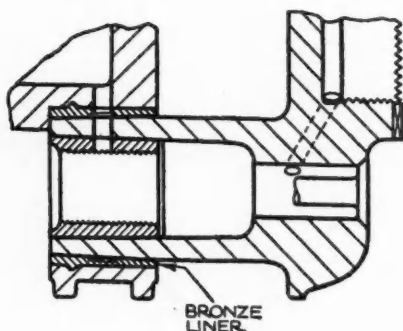
Illustrations by courtesy of FLIGHT (England)

ported by three bearings—a ball bearing in the crankcase center section and a roller bearing in each of the end sections. Each of the inner crank arms has formed integral with it one of the crankpins and one-half of the center main journal. Each of the two outer crank arms is formed integral with one of the end journals and its extension. The two parts comprising an inner crank arm each are joined together by means of the Hirth patented coupling. The faces of the center journal halves are machined with radial serrations which interlock when the two halves are drawn together by means of a threaded sleeve. This sleeve has two sections, cut with threads of different pitch, and is screwed into the hollow, correspondingly-



This part-sectioned perspective drawing of a unit taken from a Dornier 217E bomber shows the arrangement of the running gear and the main equipment drives. The type 801D unit installed in the Focke-Wulf 190 A₁ fighter has a few modifications. The more important of these are a non-adjustable nose ring slot for the oil-cooling system and the absence of flame-damping fittings on the individual exhaust pipes

Pressed-in joint of the built-up crankshaft. The expansion bush is threaded internally for an extractor tool.



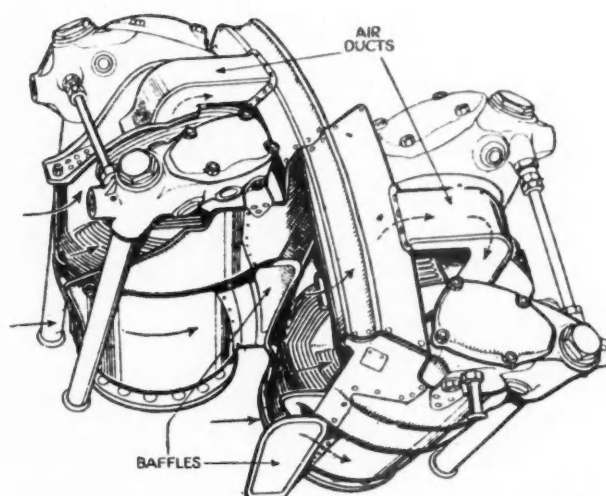
threaded journal halves. Owing to the difference in pitch, a differential effect is obtained which draws the two parts together with great force. A special type of joint, original with BMW, is used between the outer crank arm and the crankpin, and is illustrated by one of the accompanying sketches. The crank arm is bored out straight for the crankpin, and has a bronze liner with a tapered bore pressed into it. To fix the liner endwise in the bore, the latter has a circular groove cut in it near one end, and metal of the liner is forced into this groove by a pressing or rolling operation. The hollow crankpin, which has its end slightly tapered both inside and out, is pressed into the liner in the crank arm until it ends up against a shoulder, and a copper-plated tapered steel bushing is then forced into the bore of the crankpin, expanding the hollow pin and forcing it into firm contact with the bronze bushing in the crank arm. This makes a very compact joint which, apparently, has all the strength and rigidity required. The steel bushing is threaded to take a withdrawing tool. Each crank arm is formed with an integral counterweight.

Connecting-rod assemblies for both rows of cylinders are identical. Owing to the use of a built-up crankshaft, the heads of the master rods can be made solid. This rod is provided with a lead-bronze bushing in its big end. Each of the six link rods connects to the master rod by means of a floating wrist pin which has a bearing in a bronze bushing in both the master rod and the link rod. Each piston carries five rings, of which the lower two are oil-control rings. The floating piston pins are lubricated by spray or splash through oil holes in the connecting rod and the piston bosses.

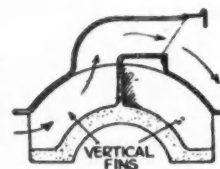
Little needs to be said regarding the cylinder assemblies, which comprise the usual finned steel cylinder barrels and shrunk-on aluminum-alloy cylinder heads. On the front row of cylinders the cast-on rocker-arm housings extend forward; on the rear row, backward. There are two valves per cylinder, with valve seat inserts of heat-resistant steel for the exhaust, and of aluminum bronze for the inlet valves. Threaded inserts are fitted into the cylinder heads also for the spark plugs and the injector nozzles, the plugs being on the forward, the nozzles on the rear side. Three concentric springs are used on each valve. There are spring clips on the valve stems which prevent the valves from dropping into the combustion chamber in the event of spring failure. Exhaust valves are sodium cooled (both head and stem),

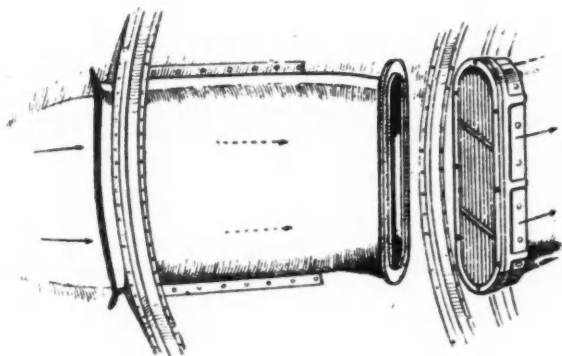
and valve seats and tips are faced with hard metal. Rocker-arm bearings and both contact surfaces of the rocker arms are lubricated under pressure through oil passages in the valve tappets, pushrods and rocker arms. Each cylinder is secured to the crankcase by means of a large number of studs with cylindrical nuts serrated on the outside. These nuts are screwed home and removed with socket wrenches, which permits of placing the stud centers close to the cylinder wall and reducing the width of the mounting flange.

Baffle plates for the cooling air are permanently secured to the cylinders, and are removed with them. The baffling system is so worked out that air is caused to flow substantially uniformly over all parts of the cylinders and heads. At each side of each cylinder there is a close-fitting baffle, and the baffles on a front cylinder form a duct which discharges into the space between rear cylinders. The spaces between the cylinders of the front row form a duct which allows air to enter the jacket formed by the side baffles of a rear cylinder, the cylinders of the two rows being staggered. The cylinder heads also are shrouded. Air enters the cooling space between the shroud and head, and is deflected downward at the back of the head by the baffle ring between cylinder rows, where it passes over the injection nozzles located between valve ports. Some of the air entering the cylinder-head shroud of the front row is carried through air ducts extending through the baffle ring between rows to the space immediately in back of this ring, the object being to prevent the formation of a low-pressure region there. There are three openings in the baffle ring between cylinder rows for each head of the rear row of cylinders. Air flowing through the two outer openings is directed against the two valve ports, while that passing through the smaller central opening is directed downward and cools the injector nozzle. One of the accompanying sketches illustrates the arrangement of the cylinder baffles.



This sketch shows the system of baffles employed to ensure distribution of air for cylinder cooling. The barrels are closely shrouded and special measures are taken to direct air over the heads and downwardly to the rear.





One of these internally mounted air scoops on each side of the unit conduct air to the blower intakes.

A single-stage centrifugal supercharger is fitted, driven through a two-speed gear with multiple-disc clutches. Drive from the crankshaft is through a driving pinion and a torsionally-flexible shaft. The change-over from the low gear, used at ground level and low altitudes, to the high gear is effected automatically through hydraulic means by the central control unit which is under the influence of altitude and the charging pressure. In high gear the blower impeller turns at 7.46 times crankshaft speed; in low gear, at 5.07 times that speed. Air is taken into the blower through two shallow scoops on the inside of the cowling on opposite sides of the engine. These air scoops (see sketch) come off with the detachable sections of the cowling and therefore cannot be rigidly secured to the blower inlet. As shown, the rear end of the scoop is pressed against a rubber gasket on the blower inlet when the particular section of the cowling to which it is affixed is fastened in position. The rotor vanes are partly shrouded, and each second vane extends along the hub to form an entry vane. The arrangement of the impeller drive is clearly shown in the assembly drawing of the engine. There are two gears free on an intermediate shaft, to which each can be clutched by means of a disc clutch. The larger of the two gears is in constant mesh with a drive pinion on the crankshaft. When the gear meshing with the crankshaft driving pinion is clutched to its shaft, the drive is through that shaft and another, large gear fastened to it, to a small gear on the impeller shaft. If, on the other hand, the second gear on the intermediate shaft is secured to the shaft by its clutch, then the drive is from the crankshaft gear to the gear on the intermediate shaft in mesh with it, to another gear on the lay shaft; from a second gear on the lay shaft to the second gear on the intermediate shaft, and from the gear fixed to the intermediate shaft to the gear on the impeller shaft.

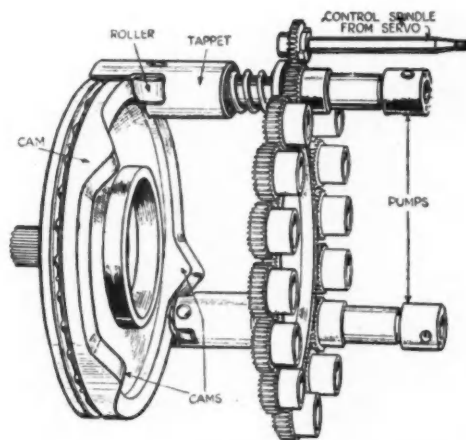
The blower housing is split in a plane perpendicular to the impeller axis. One half forms the intake, the other the delivery member. Telescoped to the rear of the inlet member is the channel-section, light-alloy mounting ring which is secured to the crankcase by studs extending through bosses on the blower housing. Bolted to the rear of the blower is the accessories housing. The rear end of the crankshaft extends through the hollow impeller shaft, and its protruding portion carries the drive gear for the supercharger,

the accessories driving pinion, and the starter ratchet. Starting is effected by means of a centrifugal starter of Bosch manufacture, which is normally actuated by means of an electric motor, but which can be hand-operated in case of emergency.

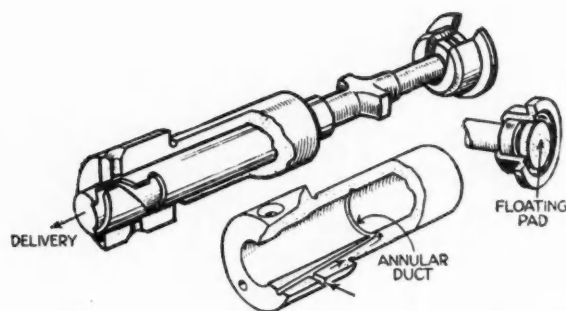
The inlet elbows of the blower are provided with spring-loaded hot-air valves which are automatically opened by the pressure drop which develops when the strainer in the inlet passage becomes choked by ice formation. Throttle valves in the inlet housing are manually controlled to give the desired charging pressure, by means of the central engine control, and automatically in accordance with the pressure of the surrounding atmosphere.

A Bosch dual magneto with two entirely separate ignition circuits is mounted over the reduction gear in the forward part of the cowling. There are two spark plugs in each cylinder head, on the inlet and exhaust sides respectively, and all plugs on the same side are connected to the magneto by the same ignition harness. All ignition circuits are completely shielded to prevent radio interference. Either set of spark plugs can be cut in and out at will. A spark-advance mechanism is incorporated in the magneto drive, and spark-timing control is effected automatically by the central control unit through a wire or cable mechanism.

The fuel transfer pump located in the gear housing at the rear draws fuel from the tank through two pipes, one of which has inserted in it the fire-bulkhead filter cock; the other, the fire-bulkhead hand pump. The transfer pump delivers the fuel to a centrifugal de-aerator at the injection pump, and from the de-aerator the fuel passes directly to the individual barrels of the injection pump. The injection pump was built by the firm of Friedrich Deckel in Munich, which has been manufacturing injection pumps practically since the advent of the high-speed Diesel engine but is best known, perhaps, for its Compur shutters for high-grade cameras. The pump comprises a cam plate with three face cams, and a series of 14 pump barrels arranged in a circle. Since there are three cams and each injection pump must perform a delivery



The fourteen injection pumps are arranged concentrically around the drive axis and actuated by a three-face cam running at one-sixth crankshaft speed. Control sleeve pinions are interconnected by a floating circular rack.



One of the fourteen individual elements of the fuel injection pump unit. The plunger has a dual "scroll" and is furnished with a self-aligning pad at foot abutting the tappet.

stroke for every two revolutions of the crankshaft, the cam plate is driven at one-sixth crankshaft speed.

The injection pump works on the same principle as the familiar Bosch pump, in that inlet of the fuel and the cut-off are controlled by the pump plunger, and the fuel is delivered through a spring-loaded delivery valve. The pump, however, has a number of original features. A drawing of the cam plate, the control sleeves of the various pumps, the tappets of two pumps, and the shaft from the control relay or servo is shown herewith, while another drawing shows details of the pump barrel and plunger. One difference between the injection pump of the BMW 801A and the conventional fuel pump is that the plunger of the latter has two tapering scrolls or lands controlling the beginning and end of injection, instead of a single one. Each pump element has a control sleeve combined with a spur pinion. The sleeve is slotted and a cross head on the stem of the plunger engages in the slots, so that any rotation of the control sleeve and its pinion is accompanied by an equal rotation of the pump plunger.

All 14 of the control-sleeve pinions mesh with a single central floating gear or circular rack. Motion is imparted to the injection-control assembly by a pinion at the end of the control shaft which meshes with one of the sleeve pinions, from which latter the motion is transmitted to all of the remaining sleeve pinions by the floating gear.

Reference was made in the foregoing to the fuel de-aerator incorporated in the injection pump. This de-aerator consists of a chamber in the cover plate of the pump housing from which tangential passages lead to an axial tube extending into the common fuel inlet pipe or fuel gallery for all of the pumps. Fuel is swirled around in this pipe and passes from it into the common fuel gallery of the pumps through a series of small holes in the cylindrical wall of the tube, while the separated air (and gas) is allowed to escape through a nozzle mounted centrally in the rear end of the tube. The outlet from the nozzle is controlled by means of a valve, which is held closed by a spring when the engine is not running, so that the pump will remain filled with fuel during shut-down periods and will be ready to begin injection as soon as the engine is cranked over. This valve is subjected to the fuel pressure, and is opened automatically as soon as the engine begins to turn and the transfer pump puts the fuel under pressure.

This description of the BMW 801A will be completed in the November 1, 1942, issue of *AUTOMOTIVE and AVIATION INDUSTRIES*.

Comparison of Synthetic Rubbers and Reclaimed Rubber with Crude Rubber as a Tire and Recap Material

Comparisons are based on average experience in latest tests, operating at speeds around 40 mph. The mileage life of a crude rubber tire at this speed is considered to be about 35,000 miles. This chart was compiled by the Baruch Rubber Committee.

	Manufacturing Efficiency	Tread Wear	Carcass Failures	Suitability as a Recap	For Inner Tubes
BUNA S (new tires and recaps)	GOOD — Mixing 40-70% Building 80-100% Curing 100%	GOOD —Tests show about 90% mileage of crude rubber.	NONE —If 10% crude rubber is used.	GOOD —Tests show about 90% mileage of crude rubber. Curing time about the same as crude rubber.	Apparently satisfactory.
NEOPRENE (new tires and recaps)	GOOD — Mixing 40-65% Building 75-100% Curing 50%	GOOD —90% mileage of crude rubber at normal speeds; 125% under severe service.	NONE —No carcass failures reported in tires tested recently. Some failures in earlier tests.	GOOD —Tests show 90-110% mileage of crude rubber recaps. Curing time longer.	Apparently satisfactory.
BUTYL (new tires)	GOOD — Mixing 100% Building 100% Curing 70-75%	FAIR —40-50% of mileage of crude rubber.	FREQUENT —65% of first tires failed, largely due to blisters which developed in the manufacturing process.	PROMISING —Adhesion with crude rubber was poor at first, but a recent development appears to have overcome this difficulty.	May be developed, but not yet satisfactory.
FLEXON (new tires)	FAIR —Similar to experience with Butyl. Manufacture slow; material soft and sticky.	POOR —Mileage in tests not more than 40% that of crude rubber.	FREQUENT —Tread and ply separation common in the few tires tested. Later tests show improvement as with Butyl.	PROMISING —Same difficulties as with Butyl.	Unsatisfactory.
THIOLKOL (recaps)		POOR —Thin, smooth recap gave only 14% of mileage of crude rubber; 25% for comparable thickness. Regular non-skid tread gave 20%.		GOOD —Curing and cooling time somewhat longer than for crude or reclaimed rubber recaps.	Unsatisfactory.
RECLAIM (new tires and recaps)	GOOD —Equal efficiency in milling, etc.; cures somewhat faster than natural rubber.	POOR —About 20-25% mileage of crude rubber.	INFREQUENT	GOOD —Curing time same as for crude rubber.	Fairly satisfactory.

Airbriefs

By HENRY LOWE BROWNBACK

Air Freight

A few days ago I was sent, for comment, an editorial written in a magazine dealing with the transportation of goods. The writer was frankly skeptical about the future of the transportation of freight by air. I am sorry that I cannot print the editorial and my reply to it. Boiled down it showed how the efficiency of aircraft increased with size and how even our largest airplanes today are in about the same stage of development as the motor truck was in the 1½ ton, solid tire days.

When we build the tremendous planes of the future we will have to meet problems particularly those of taking off and landing, but man has always been faced with problems and has met them. Some of my glider friends have shown me figures which claim that a string of gliders will give the same results as one large airplane. This will be proven or disproven within a relatively short space of time and may be part of the solution.

The editorial went on to show the high cost of operating airplane engines and gave a World-War overhaul period as that of today. Actually standard American aircraft engines of the vintage of 1936 were operating on the KLM from Amsterdam to Batavia, one of the most difficult routes in the world as far as climatic conditions go, with standard overhaul periods of 750 hours and could have gone longer. With our increased production facilities engines will be cheaper and better processes and materials will make better engines for the postwar airplanes, so we can look forward to at least 200,000 miles between top overhauls as ordinary performance. This doesn't sound like extravagant operating expense.

Shipbuilders

Mr. Kaiser has combined with Howard Hughes in a venture to build giant air freighters. I freely predict that they are going to have many headaches before they are through, but the entry into aviation of men like Mr. Kaiser, who are pure and simple organizers and not airplane enthusiasts, will do the industry as a whole lots of good. It has only survived the ordeals it has passed through because the men who kept the often feeble flame burning did so because they were aviation enthusiasts who loved the science of aviation and who put their belief in its ultimate place in the sun far above

financial loss, personal risk and often death—honor to them, and may they all reap the reward of their effort. I know many of them and have shared in the work, but I feel now that new blood, especially great organizing ability, will provide a greater impetus toward the goal for which we have all worked.

Plywood

In writing a page of this sort one must try to make it informative without being critical, which is often very difficult, as the easiest way to show mistakes is often to criticize them. When the supply of metal became inadequate and wood had to be substituted in aircraft production there were comparatively few wood airplane men available and most wood-men knew nothing about airplanes. Many woodworking plants rushed into the industry and had lots of trouble building the parts needed, which were often designed by metalmen who knew little of woodworking, and made designs which were difficult to fabricate. I have in mind a floor which could have been most simple but which, in its present form, takes far more man hours than the average small airplane. Worst of all is the ever present shortage of aviation grade plywood which is becoming more acute every day.

The war has cut off our supply of the most valuable wood for plywood—mahogany—and the ever increasing use of this material for every possible thing as a metal replacement is causing a shortage in veneers of all kinds. Designers should find ways of making simple structures using a minimum quantity of scarce woods, and most of all the accepted airplane woods are scarce.

I have seen seats made up of complicated mahogany plywood bulkheads with spruce forms, where a simple frame with canvas would have been amply strong, and pilot's seats just as complicated where one could have used the basket type of bucket seat found in the World War planes. Maybe I am wrong, but here is a clear cut function of the technical services of the armed forces. They have a clear over-all picture of this whole situation not possessed by any one manufacturer and they should guide, and dictate if necessary, design practices conceived to conserve vital materials. This is not the function of any civilian bureau, but of the armed forces which are the ultimate customers for this material.

Elmira

Some of my readers may remember an ad appearing years ago in the *Police Gazette*—"Get lots of mail, send ten cents and get hundreds of letters." I have a better formula—write a page or a column and make a mistake! Two issues back I wrote a paragraph on gliders and accidentally gave the locale of glider activities in this country as Binghamton instead of Elmira, N. Y. Now I know how the wag who ordered a Florida grapefruit in the Los Angeles Biltmore felt like.

I should have known better as I have often visited Elmira, once to see a glider meet, but more often during the beginning of the last war when I was instructing machine guns at the ground school at Ithaca, and later inspecting the manufacture of Curtiss OX5 engines at the Willys-Morrow plant. The only reason I can give for the slip is the fact that, in going, I often passed through Binghamton and my mind slipped as I wrote.

I hereby express my regret to the glider enthusiasts who have written to me and to the various organizations in Elmira which have protested.

Merchant Marine

Before the Civil War the American "Clippers" ruled the seas, but could not hold out against the British steamers after that. Today we are again at the crossroads. Will we try to hold out with a seaborne merchant marine against someone using airborne ships or will we again seize the initiative? Now is the time to plan for it. Our planes have, so far shown the way, and let us see that they continue to do so after the war by insisting as part of the peace to come that world commerce airports are as free from restrictions as seaports have been in the past. Unless we do this the future of world air commerce can be tied up in a maze of petty red tape. *Insist on postwar air freeports in every country in the world.*

Standardization

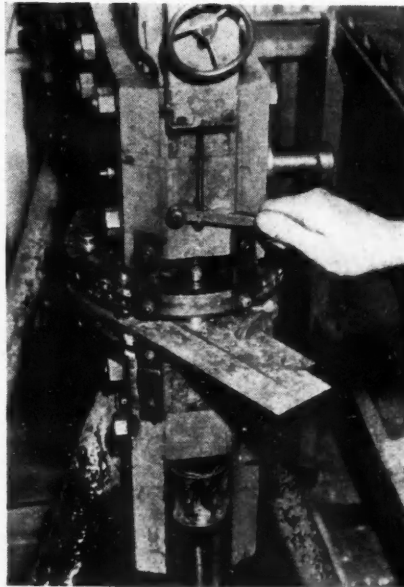
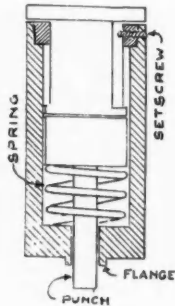
I was recently sent a clipping from the *New York Times*, part of which I wish to pass along. A transport plane which had flown nearly two million miles before it entered the Near East Ferry Service burned out an engine and landed on a sand bar in an African river. An engine from a similar plane which had crashed some 1200 miles away was flown and ferried to the disabled plane and installed by the pilot and local help and the ship flown off of a makeshift bamboo runway.

The article went on to show how all of this was made possible because of the standardization brought into being by the tireless and unselfish work of the SAE committee charged with the task over a period of years preceding the war, and how the patient and patriotic work of these groups was speeding the work of the war machine and ironing out many of the wrinkles which would have become barriers otherwise.

Consolidated

(Drawing and view at right)

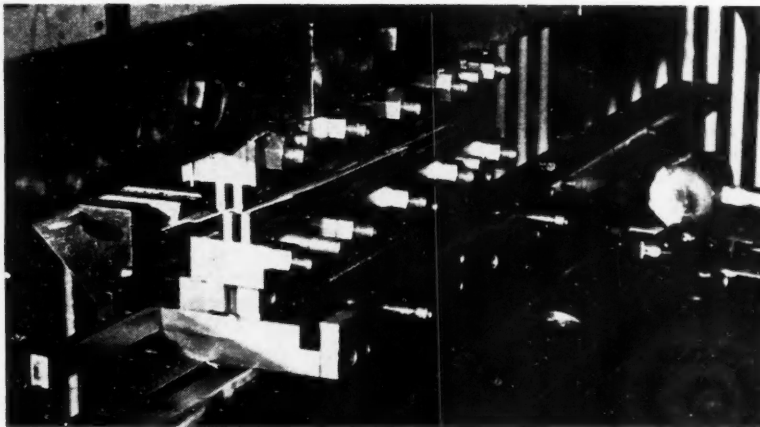
Here is a precision punching method for transferring holes in one template to a companion template by use of a pressure pad. The pressure pad is equipped with a flange projection which acts as a pilot for locating purposes. To locate a hole, a hole concentric with the flange and carrying a punch is used. In this way the pilot flange is located in the hole of one template and the punch press when operated on the punch pierces a hole in the companion template concentrically.



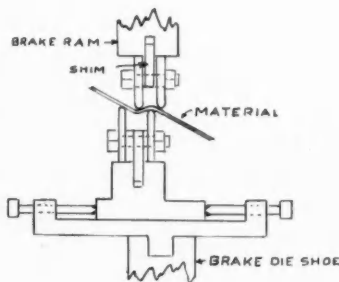
Production

Short

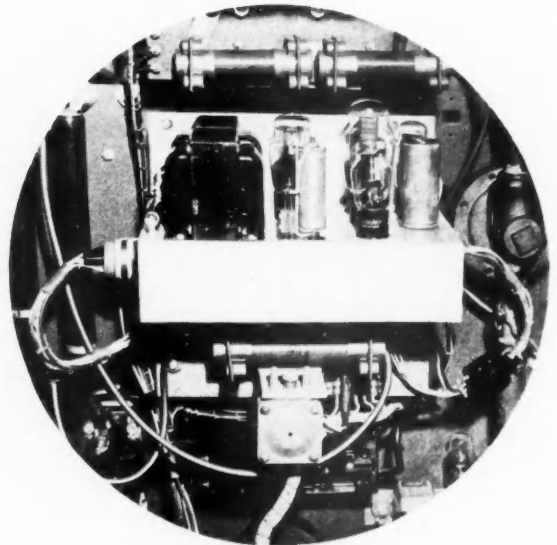
(Below) A simple handle added to the shank of a right angle drill housing doubled drilling speed. A tool steel collar 3/16 in. thick by 5/16 in. wide with a shank fitted into a standard wood handle, is locked in the desired position on the housing by two Allen bolts imbedded in holes drilled through the collar. By permitting easier and steadier direction and application of pressure, drill breakage was reduced 25 per cent, production was doubled and operators reported less fatigue. Fewer rejections were also recorded.



(Above and drawing at right) This tool is intended for use on power brakes to make two opposite bends in sheet metal simultaneously. The bends can be made from zero to 90 degrees, and they may be up to 1½ in. apart. With this tool, joggles also can be made as with ordinary joggle dies, and setups are said to be easier and quicker. Essentially on joggles requiring 90 deg. bends, only one operation is necessary. A full adjustable design is shown here.



(Circle) Consolidated engineers developed this electronic voltage control for spot welding machines. It is said to improve the accuracy of the controlled voltage, thus helping to produce more uniform spot sizes, and the cost of construction is low. The complete system can be built in a small compact unit and, in case of trouble in the unit, it could be replaced in a few minutes with a spare, and the servicing can be done on the bench.

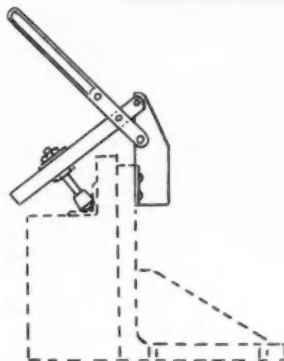
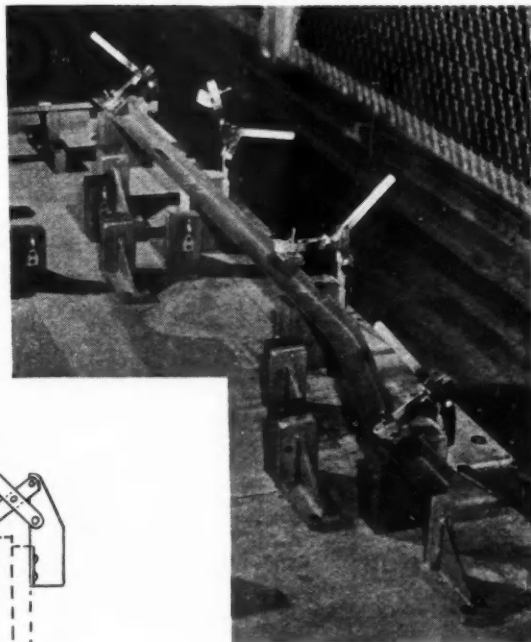


Cuts

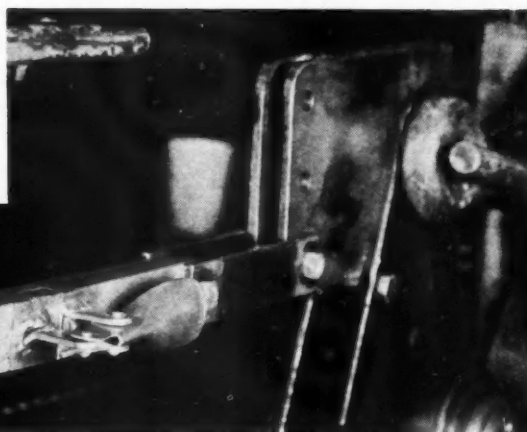
at
Aircraft
Plants



(Above) To eliminate hand burring, sanding and the use of a majority of shaper parts is the purpose of this guide for machine burring of sheet metal parts and also for use on hydro-press and brake parts after the blanking operation. The guide consists of a steel collar, the center of which is machined out to allow a certain size shaper cutter to move freely within it. The collar has three cutaways equally spaced on the outside wall. The guide rests on the chuck of the shaper and turns with the cutter until a piece of metal hits the flat part of the guide, which then stops and the exposed cutter takes off .016 in. of metal, the chips coming out of the other two cutaways.



(Above) An improved clamp of the vertical base type is used instead of the old style clamp block. Its flexibility permits the transmitting of holding force in two planes.

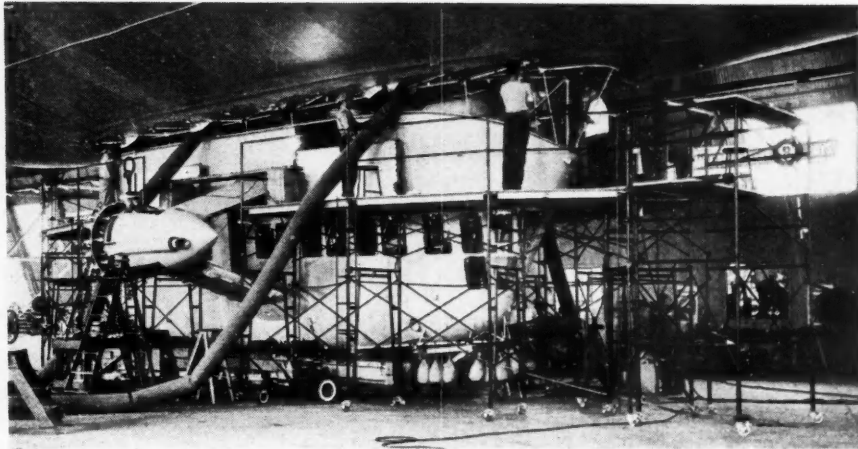


(Above) Cables are attached to the proof loading machine in considerable less time with this new clamp, which has threads in its base and in a movable portion. Upon inserting the cable terminal, the threads of the clamp engage the threads of the terminal to provide a positive clamping action.

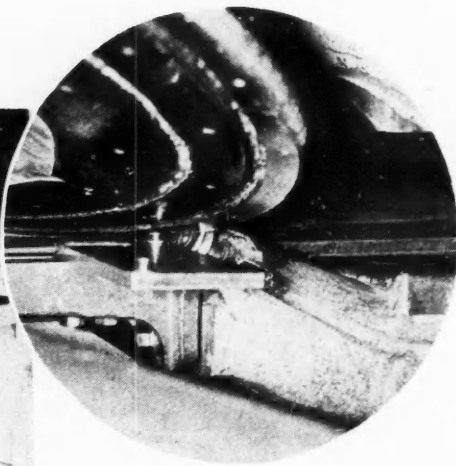
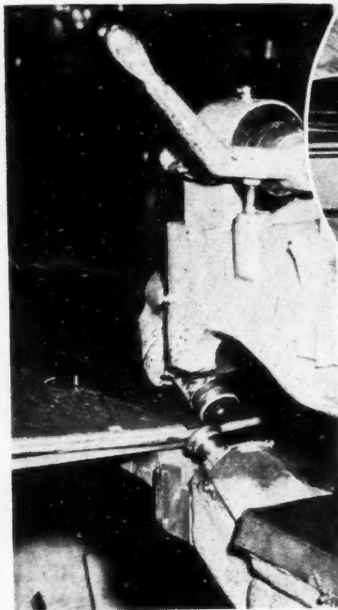


(Left) Slat-top tables facilitate the drilling of a stack of sheet metal parts and are estimated to save thousands of man-hours a year. They are easy to keep clean, for after each stack is finished, shavings can be brushed quickly between the slats, where they fall into a tray beneath the table. Vertically held radial drills are mounted on carriages, which roll on tracks made of angle iron and located at each side of a table.

Goodyear



This scaffolding surrounding the gondola of a new blimp in the Wingfoot Lake hangar of the Goodyear Aircraft Corp. was especially adapted to save many hours in the assembling of each new blimp for the U. S. Navy. Replacing a system which required "horses" and planks, the scaffolding is merely rolled away after each new blimp is assembled. When the gondola and bag for another blimp are ready, it is rolled into place again and the wheels locked by special contrivances near the floor.



(Circle) Bottom side of sheet metal cutting device. Note tracks and guide pins. The cutters will furnish power to pull the track and put through the shear. Therefore, the operator need only load the fixture.

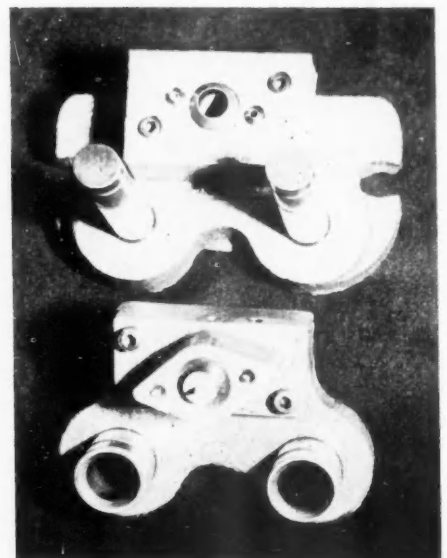
Application of a cutting guide is shown on the job for which it was created. By this simple contrivance the layout operation of an irregular curved flat piece may be eliminated. Also the use of a less skilled operator on the circular shear, as the part will automatically follow through the cutters.

Production

Short

Timm

(Below) Combined punch and dimple die for use on assemblies which have dzus springs attached to them and the counter-sunk dzus type button on the adjacent assembly. By the use of this punch and die it is possible to eliminate six operations. This saving in operations is of great concern, particularly on cowling assemblies, as there are usually a great number of dzus buttons used for assembling and disassembling the control units around the motors and various other power plant enclosure panels.



Cuts

at
Aircraft
Plants

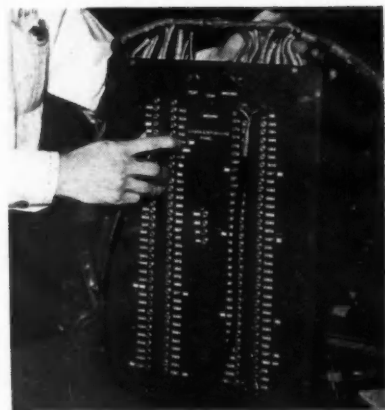
North American



(Left) Machining of hydraulic parts presented a difficult job at the North American plant. Since they had to be held to close tolerances, rough boring was done using an ordinary boring bar with pilot and spindle. To finish the job within the tolerance required grinding, then honing. And despite these exacting operations, rejects and reworks occurred too often. A "caterpillar" boring bar is now used that completely eliminates the grinding operations and reduces the honing to a minimum. Rough and finish work is done at the same time with the bar and although the man-hours on some jobs are 25 per cent less, the bar's greatest contribution is its accuracy. Rejections and reworks are rare.



(Circle) By placing all the wood forming blocks on one board has made it possible to flare, burr and do the fitting operations before the tube is formed. Heretofore those three operations had to be done after the tube was formed, the entire job requiring 10 minutes. Now it is done in approximately 47 seconds.



(Above) A test panel for testing wiring in a B-25 bomber. One man can do in 17 minutes a job that formerly required 4½ hours.



(Left) An auxiliary arm on this 100-ton press serves as an automatic feeder and allows the operator to prepare the job safely in front of the press. The stationary flat surface was replaced with a sliding plate that has increased the production of some parts as much as 700 per cent. (Above) A test panel for testing wiring in a B-25 bomber. One man can do in 17 minutes a job that formerly required 4½ hours.

The Houdry Combined

Two-Stage Dehydrogenated

THE shortage of natural rubber caused by the war led logically to the application of the Houdry process to the production of butadiene. Houdry's research of catalytic processes since 1923 and experience gained in large scale cracking and aviation gasoline plants employing his process are fully utilized in the design of Houdry Catalytic Dehydrogenation Plants for producing butadiene.

This article deals with Houdry's two-stage dehydrogenation process for production of 15,000 tons of butadiene per year in each plant. Such a plant is now being built by Sun Oil Co. for the Defense Plant Corporation to supply butadiene to the Rubber Reserve Corporation. This size plant is admirably suited for smaller refineries and for natural gasoline and recycling plants where a sufficient supply of butane is available. It can be also erected in natural gas fields where butane is separated from natural gas, while the balance of the de-butanized gas may be piped away to serve as gas fuel or stored in the ground.

Economy of Material

The design of these small butadiene plants permits the use of 60 per cent to 75 per cent of

material either existing at such plants or easily available as second hand equipment. Sun Oil Co. has found sufficient material for the construction of its plant so that of the estimated gross expenditure for this project of \$3,254,429 the actual value of the material to be used is \$1,720,000, and only \$313,686, or 18.2 per cent of this amount is represented by new critical materials requiring priority. The total weight of the material to be used in this project, excluding masonry and lumber, is estimated at 6025 tons, of which 80 per cent, or 4822 tons, consists of existing or second hand equipment and only 20 per cent of the weight of the total materials entering into the contemplated construction requires priority.

Another advantage of this process and design is that such a plant can be completed and placed in operation within six months after construction has started. After the war these plants may be converted into units for production of high octane gasoline and components of aviation gasoline at reasonable cost.

Ample Supply of Feed Stock

Butane is used as charging stock, although a mixture of butane-butylene can be used and the first stage

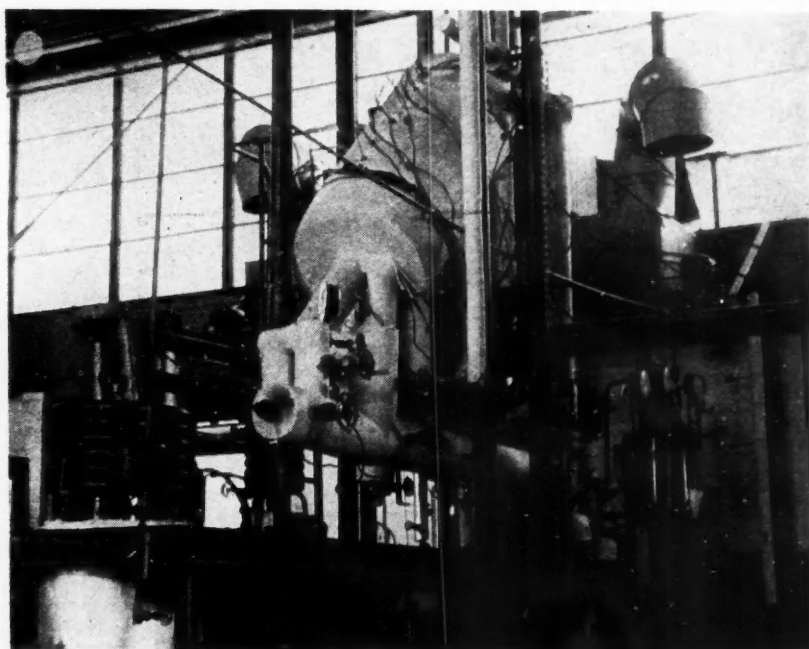
of the dehydrogenation process eliminated.

Butane, however, is preferred because it is available in large quantities in relatively pure form at refineries, as a by-product of alkylation processes for the manufacture of aviation gasoline, in natural gasoline and recycle plants. Furthermore, the use of butane does not reduce the raw material needed for the 100 octane aviation gasoline program as would be the case if butylene is used as feed stock for the production of butadiene.

Table 1

Estimated Cost, Based on All New Material, for a Houdry Combined Two Stage Dehydrogenation and Single Stage Purification Plant for Production of 15,000 Tons a Year of Butadiene

I. Process Plants	
a. Dehydrogenation Plant	\$1,902,825
b. Purification Unit	955,000
c. Auxiliaries — Services and Utilities	559,100
Total	\$3,416,925
II. General Administrative, Purchasing, Engineering & Development Expense	225,000
III. Grand Total	\$3,641,925



View of a Houdry Butadiene plant

Catalytic Process

A careful survey of the potential normal butane production at natural gasoline plants and refineries in the United States based on actual 1941 production figures published by the U. S. Bureau of Mines and published data for the first five months of 1942 permit the following estimate of potential n-butane production for the current and future years up to 1944 inclusive:

Normal butane is, therefore, available to the extent of at least 175,000 barrels per day.

Due to the high yield of butadiene obtained from butane in the Houdry process, 44 plants of this type, charging each 677 barrels of butane or a total of about 30,000 barrels daily, can produce 660,000 tons of butadiene annually, sufficient for the final production of 880,000 tons of rubber, or the entire tonnage proposed at present by the Government to be produced from petroleum.

By making fullest possible use of existing equipment, an expenditure for new critical material of less than \$40-million would suffice to build these plants. The first 300,000 tons of annual capacity of butadiene could be in operation within 6 to 7 months and the total required capacity of about 600,000 tons within 9 months after beginning of construction.

All Houdry plants are designed to operate on very short on-stream periods. Each on-stream period is followed by a regeneration step, whereby carbon deposited on the catalyst is removed and the catalyst maintained in a very active condition. The useful life of the catalyst is expected to be more than six months. Due to the relatively pure form of the charging stock the carbon deposit is comparatively small.

* Chief Engineer, Sun Oil Co.
** Houdry Process Corp.
*** Consulting Engineer, Sun Oil Co.

Operating temperatures are relatively low so that requirement for materials and expensive alloy steels is kept to a minimum. Likewise, utilities such as steam, fuel, power and water required are low and less material is needed for plant and equipment to supply them. The equipment of the dehydrogenation unit for production of butadiene is similar to that used in the existing Houdry catalytic plants. The reactors, or

Material Requirements for Houdry Combined Two Step Dehydrogenation and Purification Plant for Production of 15,000 Tons/Year Butadiene

	Weight—Tons		
	Dehydrogen and Separation Un.	Purifi- cation Unit	Total
1. Carbon Steel Plate.....	293	250	543
2. Structural Steel	484	143	627
3. Reinforcing Steel	63	19	82
4. Steel Tubular Material.....	1015	360	1375
5. Steel Forgings	68	38	106
6. Forged Steel Valves.....	3	2	5
7. Cast Steel Valves.....	234	38	272
8. Cast Steel Castings.....	109	..	109
9. Carbon Steel Bolts	10	3	13
Total Carbon Steel.....	2279	853	3132
10. Cast Iron Castings.....	42	34	76
11. Cast Iron Castings (Heat re- sisting)	15	..	15
12. Cast Iron Valves	25	13	38
Total Cast Iron.....	82	47	129
13. 27% Chrome Steel Plate.....	30	..	30
14. Low Alloy Steel Bolts.....	10	3	13
15. Cast Brass Valves.....	1	1	2
16. Brass Tubing	19	..	19
17. Brass and Bronze Plates and Bars	63	..	63
18. Copper Cable and Bars.....	16	..	16
19. Lead Cable Covering.....	6	2	8
Total Non-ferrous Materials	105	3	108
20. Machinery	465	60	525
(Compressors, exclusive of refrigeration)	2450 H.P.	470 H.P.	2920 H.P.
21. Electric Motors, number.....	4	5	9
(Exclusive of refrigeration)	295 H.P.	191 H.P.	486 H.P.
22. Transformers, number	2	..	2
23. Switch Gear, number.....	2	..	2
24. Instruments and Controls.....	9	3	12
25. Special Equipment (Cycle Timer, Etc.)	3	..	3
26. Insulation	375	125	500
27. Welding Rod—Alloy	3	..	3
28. Welding Rod—Carbon Steel..	24	8	32

Table 3

Utilities required for a Houdry combined two stage butadiene plant and purification plant to produce 15,000 tons per year.

Electric Power	33,600 KWH/day
Fuel Oil or Gas (80,200,000 BTU/hr.)	309 bbls./day
Steam	2,000,000 lbs./day
Cooling Water Circulation.....	10,000 g.p.m.
Makeup Water for Cooling.....	300 g.p.m.

If process steam is first expanded through drivers the above electric requirement may be correspondingly reduced.

The above electric power requirement includes refrigeration equipment. If steam or gas driven refrigeration compressors or steam jet refrigeration is used, the power consumption may be reduced by 18,000 KWH per day.

catalytic vessels, six in number, are of simpler design than in cracking plants.

The Process

The charging stock, butane, is subjected to dehydrogenating conditions in the reactors in two stages. The first stage yields butane, butylene and lighter gas. The butane and butylene portion is concentrated in a vapor recovery system to produce the charge for the second hydrogenating stage in which the butadiene production is effected.

The heat required for the chemical change of butane to butylene and from butylene to butadiene is furnished by burning the carbon deposit on the catalyst during the dehydrogenating stages. The regeneration of the catalyst is accomplished by burning the carbon deposit by passing air through the catalyst. The reactors possess sufficient heat storage capacity to eliminate wide temperature fluctuations, and pressure and rate of flow are regulated so as to balance the heat required for the chemical reactions with the heat supplied by the burning of the carbon deposit.

The Houdry process, so far as we know, is the only process which developed the technique of utilizing the adiabatic cycle of heat produced dur-

ing the burning cycle of the carbon as the principal source of heat required for the dehydrogenation cycle.

The separation and purification of butadiene may be effected by one of the available purification processes.

Yield

The high yield of butadiene obtained in the Houdry process as shown in the following table is the result of its unique operating cycle:

OVERALL MATERIAL BALANCE FOR 15,000 TON PER YEAR

HOUDRY BUTADIENE PLANT

Fuel gas	23.6%
Catalyst deposit	9.5% (burned in the process)
Butadiene	66.9%
	100.0%

This material balance allows for losses in butane absorber and is based on 90 per cent recovery of the butadiene in the purification process.

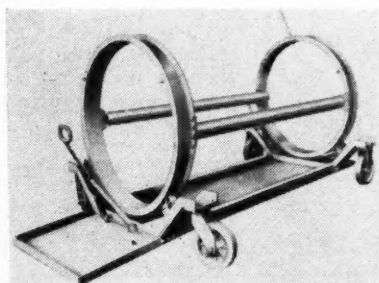
Full details of the process cannot be given since Secrecy Orders issued by the U. S. Government preclude their disclosure, except when permits are obtained by persons or companies interested in the erection of plants to utilize the process.

Table 4

Estimated Production Cost for a Houdry Combined Two Stage Butadiene Plant to Produce 15,000 Tons per Year, Including Purification Plant

	Base Price	Quantity	Calendar
		per Day	Day
1. Electric Power	\$0.007/KWH	33,600 KWH	\$235
2. Fuel oil burned, (6,000,000 BTU-per bbl.)	1.10 bbl. dld. in Tex. or Okla.	309 Bbls.	340
3. Steam (from fuel or gas).....	.33/M lbs.	2,040 M lbs.	673
4. Cooling Water008/M gal.	10,000 g.p.m.	115
5. Makeup Water15/M gal.	300 g.p.m.	65
6. Operating Labor:			
Process Plant—10 men at \$1.20 hr.....			288
Laboratory—5 men at \$1.20 hr.....			144
Undistributed Labor and Supervision.....			100
7. Catalyst			165
8. Solvent			216
9. Inhibitor			10
10. Maintenance (excl. boilerhouse and water system) 6% of \$3,036,420			500
11. Taxes, Insurance—1% of \$3,036,420.....			83
12. Total Operating Cost			\$2,934
13. Butane Charge	\$0.06 gal.	677 bbls.	1,706
	2.52 bbl.		
14. Fuel Gas Credit	1.10 bbl.	158 bbls.	174 (Cr.)
15. General Administrative Costs \$0.075/lb. Butadiene.....			684
16. Royalty at \$0.00125/lb. Butadiene.....			115
17. Total Cost (excl. Amortization)			\$5,263
18. Cost of butadiene (excl. of amortization) based on 66.9% yield from butane			per lb. \$.06421

New Engine Assembly Stand



A NEW engine assembly stand for holding large in-line aircraft engines in any desired position during assembly or overhaul is being manufactured by the Aviation Division, Whiting Corp., Harvey, Ill. Its important features are the rotating rings and

Engine assembly stand manufactured by the Aviation Division, Whiting Corp.

horizontal tubular members to which the engine brackets are bolted. This design reduces the superstructure to a minimum and provides accessibility.

Another Whiting development, a propeller trailer, is a specially designed unit that simplifies the storing and handling of standard aircraft propellers. Tubular steel construction of this unit is said to provide great strength with a minimum of weight.

Sheet Metal Forming

Part Two

By F. R. Shanley

Part One appeared in the October 1, 1942, issue of AUTOMOTIVE and AVIATION INDUSTRIES.

JOGGLES represent an acute case of curved flanges, in which the curvature is severe and highly localized. Since joggles are widely used in the design of sheet-metal parts, special efforts have been made to facilitate their production in the shop. Even in the forming of annealed material on the hydropress it is frequently necessary to "hand-set" the joggles after forming, because of the inability of the rubber pressure to produce the necessary local change of shape. This trouble is not a bending problem, but is due to the stretching and shrinking strains that must be produced to form the double-curved part.

Formation of joggles by the use of the "dishing" principle has been successfully done at Lockheed (see Fig. 18), and is described in detail in Ref. 7.

Stretching

The stretching process must be used to form sheet where springback from

Such a stress obviously lies below the yield stress for heat-treated aluminum alloy, indicating that forming by simple bending would be practically impossible (unless rolls were used to produce a high degree of localized bending). The conditions just described are shown in Fig. 20, in which the stress conditions on the inside and outside surfaces of the sheet during bending are represented by (a) and (b), respectively, the strain along the neutral axis being zero. Upon release of the bending forces, the recovery would be purely elastic and the bending strains would disappear entirely; (a) and (b) would both return to zero.

It is possible to eliminate springback very effectively, however, by a combination of bending and stretching, as shown in Fig. 19. Assume that a force T is applied such as to produce a tension strain well into the elastic range. This strain is superimposed on the bending strains, producing conditions

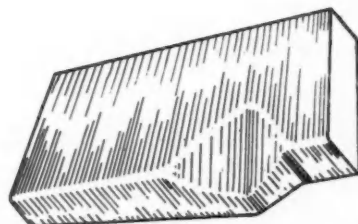


Fig. 18—Form block for single joggle.

at the surfaces of the sheet such as indicated at (a') and (b') Fig. 20. The difference between strains (a') and (b') is the same as that between strains (a) and (b) and is therefore sufficient to allow for the desired bend. Now if the tension load is removed, the elastic recovery will be as indicated by the dotted lines. Note that the difference between the residual strains (a'') and (b'') is very nearly equal to that between strains (a') and (b') existing during forming; hence the sheet will remain curved after the stretching force is removed, with springback virtually eliminated.

In the foregoing examples the part was assumed to be formed to a cylindrical surface. The same principles

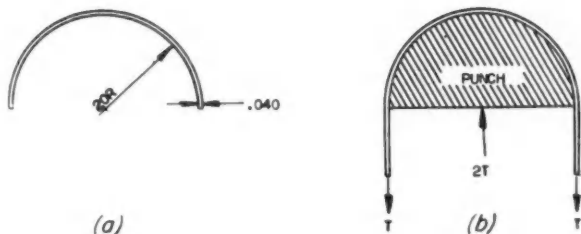


Fig. 19—Forming by stretching.

simple bending is too great. It has been explained that in simple bending the elements in the neutral plane are not elongated, and all permanent set arises from deformations in the outer fibers. However, if the ratio of R/t is large, the deformations of the fibers will not be sufficient to place the material in the plastic range; hence in such cases it is impossible to form the part simply by bending it to contour. As a simple example, consider the case shown in Fig. 19. From the equation already given,

$$e_{max} = \frac{t}{2R} = \frac{0.040}{2 \times 20} = 0.001$$

$$f_{max} = e_{max} \times E = 0.001 \times 10,000,000 = 10,000 \text{ psi (for aluminum alloys).}$$

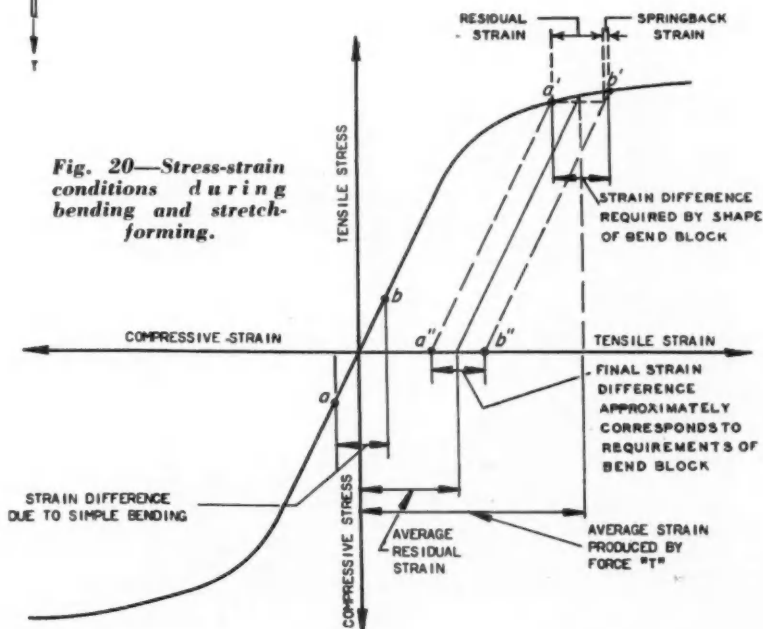
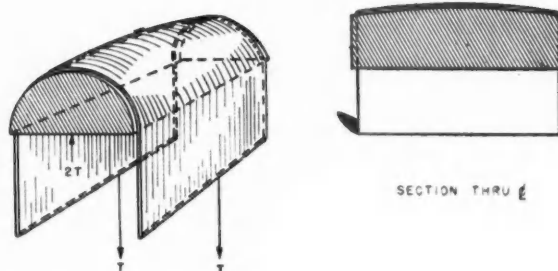


Fig. 20—Stress-strain conditions during bending and stretch-forming.

apply when the surface has double curvature, as shown in Fig. 21. The only difference is that the amount of stretch will vary between the center-line of the sheet and the edges. The limits to which this process may be carried will therefore depend on the maximum stretch required at any point in order that *all* points are strained into the plastic range. If the maximum tensile strain should exceed the allowable value at any point, the material will of course fail in tension. Hence a material having a high maximum elongation over a large gauge length must be used, in severe cases.

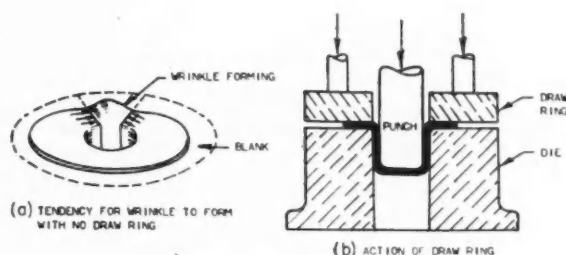
A part having *one* deep contour of curvature, the other being relatively shallow, as in Fig. 21, can be formed by stretching, as described above. But if the part is deeply contoured in *both* directions, it is impossible to obtain enough stretching action without tearing the sheet; hence the part must be formed by the drawing process to be described later in this paper. The greatest value of the stretching process lies in the forming of shallow-contoured

Fig. 21—Stretching to a doubly curved surface.



at the edges while the punch forms it, thereby building up the desired tensile stress. This is illustrated by Fig. 22. A slight contour is formed in the longitudinal direction and it is to form this very shallow contour that the stretching has to be done. Stretching may also be accomplished in the single-acting press with rubber punch by the use of special, concave blocks in which the sheet is clamped at the edges by means of beaded plates or other devices. Mechanical stretching machines are also available for this type of work.

Fig. 23—Prevention of wrinkles by draw ring in double-acting press.



skins difficult or impossible to form in any other way except by hand rolling. Sometimes the necessary degree of stretch has to be obtained by using an extra-deep punch with the desired shallow contour formed only over its bottom area.

At Lockheed the double-acting press has been used to advantage in this work, as it permits the part to be held

These methods are generally not as satisfactory as the double-acting press, however, as the latter permits greater control over the edge restraint conditions.

As previously explained, the critical feature about stretch-forming is the danger of exceeding the maximum allowable strain before all portions of the sheet have been stretched to con-

tour. This problem becomes even more serious at the point of attachment of the sheet to the stretching device or press. Since operations are conducted in the plastic range, the tensile stress will necessarily be high and will approach the ultimate stress as the limits of formability are approached. If any material is removed for rivet holes, pins or other holding devices, the local stresses will be increased appreciably, thus greatly reducing the range of forming that may be done without failure. Our experiments have shown that the most efficient method of holding the sheet is to clamp it between two relatively smooth surfaces, using a high normal pressure to keep the sheet from slipping. The use of a carefully polished and lubricated punch is essential to successful results.

The range of forming that can be done by stretching may be further extended by deliberately permitting the sheet to slip between the clamping plates over certain critical areas. This may be done by proper control of the clamping pressure. The conditions thus obtained begin to approach those of "drawing," which will be taken up later.

The effect of Poisson's ratio must be considered in stretching operations. If the sheet were completely restrained on all sides and then stretched in one direction only, transverse stresses would be built up. This biaxial tension condition would tend to lower the permissible elongation, as described previously. Hence it is best to leave two edges free. In the case of a double-contoured part, it has been found best to restrain the sheet along the edges which have the smaller depth of contour.

The adoption of stretch-forming techniques as described above has eliminated a great deal of hand-work with speed-hammers, crown rolls, etc., which was formerly necessary in forming double-curvature parts. It has also made possible the forming of shallow-contour parts in hard tempers (24ST Alclad, 1/4H stainless steel) which formerly had to be made in the annealed grades. A further discussion of the stretch-forming technique at Lockheed will be found in Ref. 8.

Drawing

As applied to sheet-metal forming the term *drawing* implies that the material being formed is "drawn" from

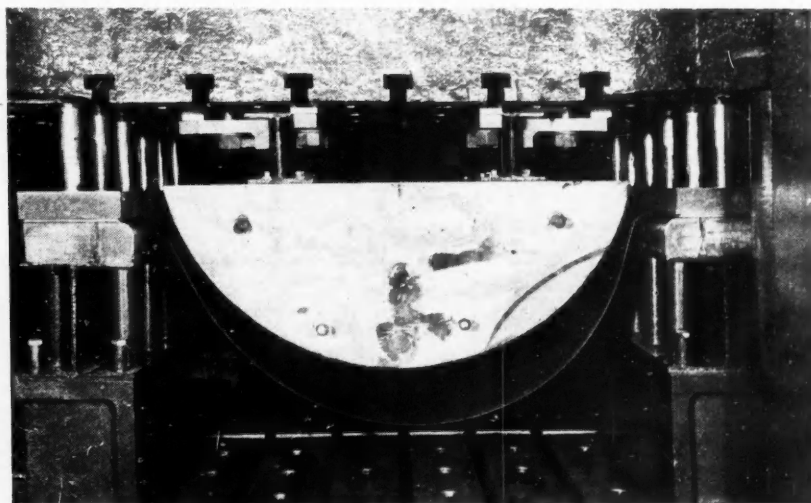


Fig. 22—Use of double-acting press in stretch-forming.

the unformed portion of the sheet in a progressive operation. More specifically, the term "drawing" is used to define the class of operations in which stretching in one direction is accompanied by compression normal to this direction. As pointed out earlier in the paper, a high degree of plastic deformation due to diagonal shear slippage is obtained under such conditions, without danger of tensile rupture, and this permits much greater elongations than those usually obtained.

Drawing of sheet metal is a well-developed process in many industries, but its application to high-strength aluminum alloys had not received much

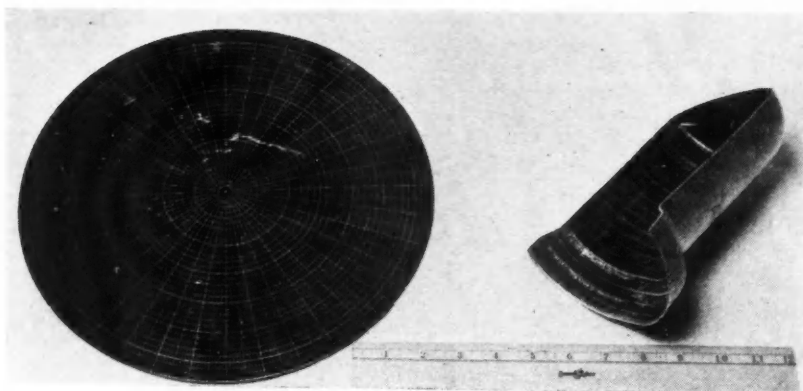


Fig. 25—Drawn cup with polar coordinate grid.

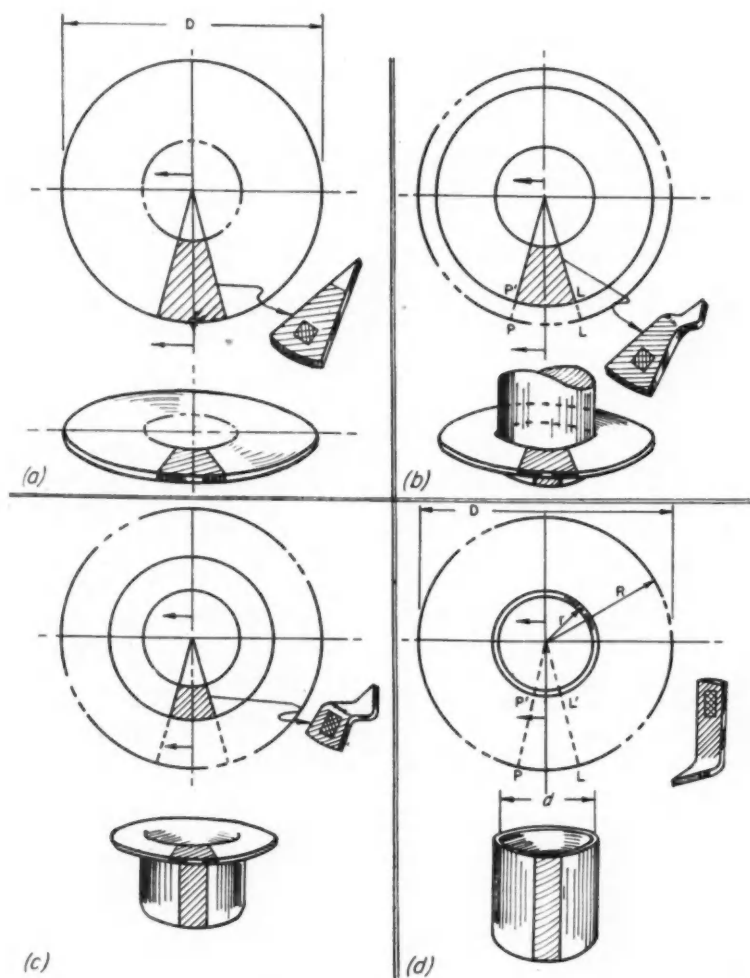


Fig. 24—Stages in drawing a cup.

attention until recently. Lockheed's research work was therefore directed toward such materials. The results (Ref. 9) have been most encouraging and have shown that under proper conditions the "aircraft" aluminum alloys can be severely formed by this process.

The process itself is best illustrated by the drawing of a cup from a flat disk. The most important feature of the process is the use of the draw ring, illustrated in Fig. 23. This ring is

forced against the metal just enough to prevent it from wrinkling, but not enough to prevent slippage.

As the punch descends, the metal flows around the drawing radius, is elongated along the axis of the cup, and is compressed in a circumferential direction. This action takes place almost entirely underneath the draw ring and around the drawing radius, not in the die itself as might be expected. (This point brings out clearly the im-

portance of the draw ring.) Successive stages of forming are illustrated in Fig. 24, in which a segment of the sheet has been shaded so as to show its change of shape. Note that radial lines become parallel as the material passes around the drawing radius. This has been proved by actual experiments, in which a radial gridwork of lines was first photographed on the sheet, as shown in Fig. 25.

Figure 24 shows what happens to a square element as the drawing process takes place. As the diameter of the blank decreases, the metal is compressed circumferentially and is stretched radially. This causes the square element to become narrower and longer, as indicated by the small shaded area on the segment. This type of strain is associated with "shear slippage" and results in high allowable elongation in the tension direction.

Experiments conducted at Lockheed have produced many interesting results, some of which are described in Ref. 9 and noted below:

(a) Tensile strains as high as 110 per cent have been produced in 24SO Alclad without failure. 24ST has been strained 22½ per cent in this manner and 24SRT, 10 per cent.

(b) 24SO Alclad may be drawn into a cup in one operation if the inside diameter of the cup, after drawing, is not

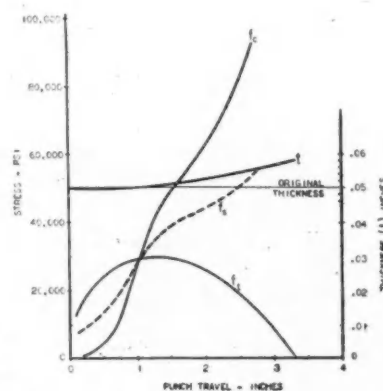


Fig. 26—Stress conditions in drawn cup.

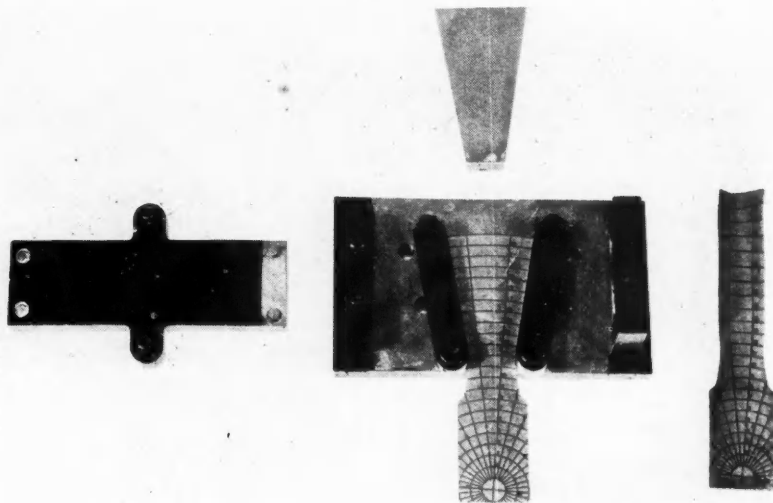


Fig. 27—Wedge draw test jig.

less than 55 per cent of the original blank diameter.

(c) Since the forming is done largely by shear deformation (change of shape without change in area) the size of the original blank to be used may be quite closely calculated by figuring the total surface area of the final part.

(d) For unusually deep draws, successive forming may be used, in which a large diameter cup is first produced, then redrawn to a smaller diameter. By using three draws, 24SO Alclad has been successfully formed into a cup having a diameter ratio (cup to blank) of about 36 per cent, without immediate annealing of the material.

(e) Limited tests indicate that a drawing radius of about five times the sheet thickness is satisfactory for 24SO Alclad material.

(f) Parts of irregular shape (such as window frames) may be considered as being made up from segments of cups and the same general technique and calculations may therefore be applied. Draw ratios obtainable at the corners are favorably affected by the flow of metal from the adjacent straight sides. (See Ref. 10.)

(g) Careful design of dies is essential for perfect results. Where very large quantities of parts are to be formed as in the automotive industry, the use of steel proves economical; but if quantities of the order of a thousand or so are involved, materials such as zinc alloy can be used with equal success provided die design is as carefully carried out as with the steel dies. (See Ref. 11.)

Stress Variations in Deep Drawing

Figure 26 shows how the stress relationships change during the drawing process. The curves, which are derived from theory and test data, show the conditions at the drawing radius. The shear stress f_s is computed from the combined components of the compressive stress f_c and the tensile stress

f_t in a manner already discussed. It is the stress responsible for the pronounced plastic flow of the material. There are other shear components, introduced by the tensile and compressive stresses, but these are manifested only by a slight effect on thickness as described later.

At first the tensile stress f_t increases quite rapidly, as the punch must exert a large force in order to produce lateral compression of the flat sheet which is under the draw ring. As drawing progresses, the area of the flat sheet under the ring decreases and the tensile stresses therefore begin to decrease also. The first critical condition occurs at or near the point where the tensile stresses are at a maximum. If this condition can be passed through without failure, the operation will be successful unless a point is reached at which the material in the flange portion fails in shear (see curve f , Fig. 26).

Figure 26 shows that the thickness at first decreases slightly, due to a shear component introduced by the high tensile stress. However, the thickness tends to increase toward the end of the operation because of the high ratio of compressive to tensile stress then present. The shear component of the former squeezes the material upward, so to speak, against the opposing thinning tendency of the hold-down pressure and the shear component of the tensile stress. A further detailed discussion of the stresses during the drawing operation will be found in Ref. 12, Part II.

The Wedge Draw Test

Since conditions during deep-drawing are quite different from those produced in the ordinary tension test it appeared desirable to find some form of simple test by which the deep-drawing qualities of a material could be evaluated. Lockheed production research engineers have developed the "wedge draw" test (originally devised by Sachs and others) to a point where it simulates very

closely the actual drawing conditions (Ref. 12). The basis of this test is the segment of a disk such as that shown in Fig. 25. Such a segment is cut out as a coupon and inserted in a special test jig, shown in Fig. 27. In this fixture the coupon is placed in the jig and then pulled out. The extent to which it is pulled out and stretched before breaking is a direct measure of the extent of deep-drawing that the material will withstand. This limit may be expressed as the ratio of r (radius of cup after drawing) to R (radius of original blank).

In Fig. 28 is shown how the grain structure was refined progressively (after recrystallizing heat treatment) by cold-working as the specimen was drawn through the die previous to heat treatment, the cold-working being the greatest the outer end.

Other Forming Processes

The foregoing discussion includes most of the forming processes that lend themselves to analytical study. Other well-known methods which may be mentioned briefly are: drop-hammer, rolls, drawbench, and dimpling. The main difficulty in drop-hammer work comes from wrinkling, which is caused by the absence of a draw ring such as described under "deep-drawing." Once wrinkles have started it is difficult to eliminate them. Although the hammer-

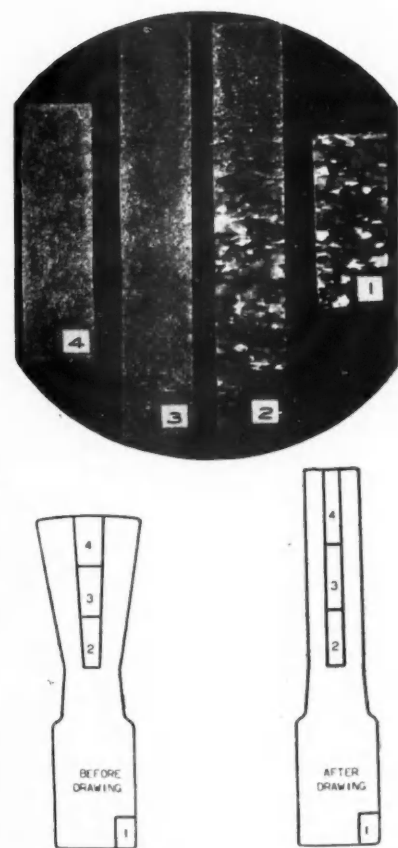


Fig. 28—Refinement of grain structure after heat treatment due to wedge draw test before heat treatment.

ing action obtained on the drop-hammer does eliminate some wrinkles, it is nearly always necessary to work out the wrinkles by hand-hammering between successive forming operations. This work-hardens the material and seriously limits the subsequent forming.

Rolls are used primarily to form thin sheet, which would have excessive springback if bent to a form block. The rolls apply a local bending strain which is great enough to cause permanent set. This local condition is applied progressively as the sheet passes through the rolls. The springback analysis may be used to determine the approximate local radius of curvature that must be produced by the rolls.

The drawbench, as applied to sheet-metal work, is usually used to form long stringers from strip stock. The operation is a combination of stretching and local bending. Rolls are often used as dies. The stretching principle is effectively used to eliminate wrin-

kling that occurs during heat-treatment.

Dimpling may be analyzed by calculating the amount of stretch required. Cracking of dimples may be predicted and explained on the basis of local elongations. The process of "forging" the dimple to prevent cracking is a good example of increasing the permissible elongation by the application of combined tension and compression, as described previously. A complete knowledge of material properties under combined stress conditions would enable such problems to be solved analytically, thus eliminating much "trial-and-error" experimentation.

Relative Formability of Materials

One of the objectives in the Lockheed forming research program has been to develop suitable criteria by which various materials may be compared as to formability. From the foregoing dis-

cussion it is obvious that there is no single characteristic that may be used to cover all forming problems. We have therefore established, in addition to the standard characteristics, certain criteria for each general class of forming. These are as follows:

Local Bending and Stretching:

Elongation, (%), in $\frac{1}{4}$ in.

Stretching (Long lengths):

Elongation, (%), in 40 in. to 50 in.

Shrinking:

$E'/F_{cy} = \text{Tangent modulus/yield stress}$

Deep Drawing:

Maximum r/R ratio (See Fig. 24)

The relative formability of various aircraft materials differs depending on which type of forming is being considered. Some very interesting work has been done at Lockheed on this subject, and will be described in a subsequent paper to be published in an early issue of AUTOMOTIVE and AVIATION INDUSTRIES.

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Suggestions Pour in from G.M. Workers

Workers in General Motors war plants have been turning in "produce more for victory" suggestions at the rate of more than 200 a day since last April, when GM launched its suggestion plan to increase war production.

Every day, on the average, 32 "war winners" are accepted by General Motors production experts. Every day more than \$1,000 in War Bonds and Stamps is awarded to lathe operators, inspectors, cutter sharpeners, sweepers and scores of other GM men and women on the production front.

These figures were revealed in a report by B. D. Kunkle, vice president of General Motors in charge of manufacturing. Covering the period from April 1 to August 31, the report disclosed that a total of 31,777 suggestions had been received from workers in 31 divisions of the company. This is at the rate of 15.4 suggestions per 100 hourly rated employees for whom the plan was instituted.

As of August 31, a total of 25,278 suggestions to improve working conditions and speed war production had been carefully reviewed. Those accepted totaled 3,938 or 16 per cent. An

indication of the increased interest and thought being given by employees to making suggestions is the fact that the percentage of usable suggestions submitted increased from 13 per cent in May to 19 per cent in August. Thus there has been a constant improvement in the quality of the suggestions.

Awards made during the period covered by the report totaled 3,487. War Bonds and Stamps with a total face value in excess of \$150,000 have already been distributed to recipients of awards.

"General Motors workers can be proud of this record," Mr. Kunkle said. "The number of suggestions turned in—more than 31,000 in the space of five months—indicates the real interest of workers in the program and demonstrates the vitality of such a plan. Currently, one out of five suggestions is being found worthy of an award, indicating increased interest and earnest study on the part of the men and women in the plants.

"The interest shown by the employees is appreciated, even when suggestions are of such a nature that they can not be adopted and put into effect. A

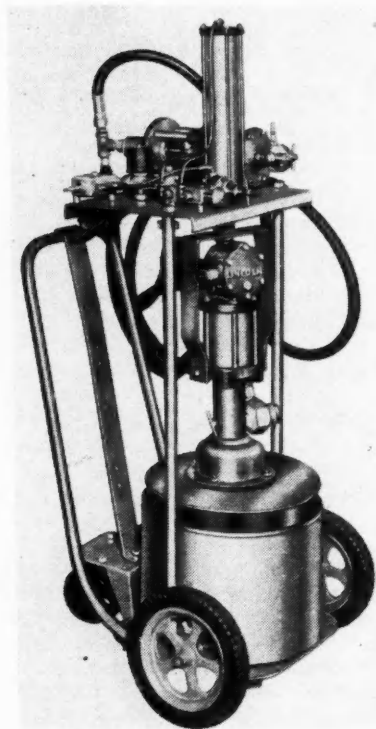
special effort is made in all such cases to explain to the employee the reasons why his suggestion can not be used.

"While averages of suggestions made and accepted are high for the whole Corporation, the records of many GM divisions have naturally been much better, depending on the interest of the employees and the newness of the work. Workers in the Allison Division have turned in 5,543 suggestions, or 47.1 per 100 employees. Rochester Products and Aeroproducts Divisions, with fewer employees, have received 55.5 and 53.7 suggestions per 100 employees respectively.

"Fisher Body Division leads with the greatest number of workable suggestions—654, or 22 per cent of those received, a good record for a large division and better than the Corporation average for the number of usable suggestions. A small division, Packard Electric, has found usable 43 per cent of those reviewed, while the AC Spark Plug Division has received 239 acceptable suggestions, or 30 per cent of those received. To date, seven divisions have had suggestions submitted found worthy of \$1,000 Bond awards."

New Production

A 250-TON hydraulic press of the semi-automatic hot molding type, with an electrically-timed cycle, was built recently by the E. W. Bliss Company, Brooklyn, N. Y. A feature of this press is that the lengths of the preliminary-cure, gassing, and final-cure periods can be adjusted independently. A variation of this control affords independent timing of a chilling period, if required, and an independent timing of the flushing of the mold passages at the completion of the cycle. The ability to change from the quick advance speed to the pressing speed before contact insures entrance into the mold at a low speed, which is particularly advantageous when working fine molding powders.



Lincoln Series 50 Pump

The patented guiding of this press, while accurately guiding the platen on the rods by means of bronze bushings with close clearances, allows expansion of the heated platen. The pressure exerted by the press is adjustable throughout a 10:1 range, and the automatic cycle may be stopped at any point by means of an emergency stop button. Owing to the fact that there is no mechanical connection between the press and the pumping unit, the latter can be placed either some distance from the press or immediately behind it, in which latter case it can be covered by a shield that will form a shelf for inspection or other purposes.

THE Series 50 Lincoln portable forced-induction pump is the latest addition to the line of "Pile Drivers" manufactured by Lincoln Engineering Co., St. Louis, Mo. Materials such as sealing compounds, sound deadeners, insulating varnishes, putty, viscous grease, heavy lubricants, etc., which are ordinarily handled by laborious hand methods, can be pumped directly from the original container to the point of application by the Series 50 pump, which embodies the principle of forced induction priming.

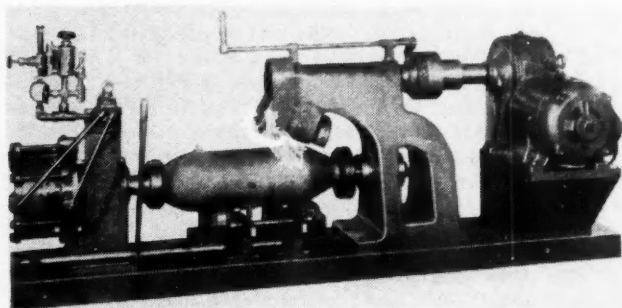
A NEW transparent plastic having many times the abrasion resistance of other clear plastics has been developed by the Columbia Chemical Division of the Pittsburgh Plate Glass Co. However, because of priorities and other restrictions, it has been impossible to place it in production so far, and for some months to come it will be available only for experimental purposes. This new plastic, called C.R. 39, is insoluble in acetone, benzene, toluene, alcohol, gasoline and other common solvents. C.R. 39 is claimed to have a resistance to abrasion from 10 to 30 times greater than other plastics of the same type. It retains its shape when exposed to high atmospheric temperatures, and it can be formed into large

sheets, either clear or laminated, by the application of low pressures. In the form of transparent sheets it compares favorably with other transparent resins with respect to strength, weight, clarity and impact resistance.

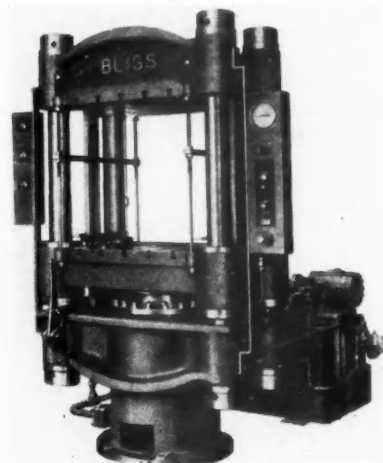
THE Matthews No. 203 bomb-marking machine, a new product of H. S. Matthews & Co., Pittsburgh, Pa., has been developed for marking all required data on the conical tail surface of bombs. Adaptable for installation in production lines, it completes the marking noiselessly. The machine provides for variations and irregularities in the bomb surface to be marked, to assure complete and legible impressions. It is semi-automatic and is made in various sizes for marking 100-lb to 1000-lb bombs. It is usually installed between sand-blasting and hydro-static tests.

WAR production has greatly increased the demand for small gears of from 1/4 to 4 in. pitch diameter, for use in navigation instruments, range finders, gun-sighting mechanisms, sound-detection equipment and bomb sights. For such applications the gears must be finished to a high degree of accuracy.

In order to speed this critical finishing operation, the National Broach and Machine Company, Detroit, has developed the Red Ring GCL-3", a small gear-shaving machine. This machine, it is claimed, will finish gears of the sizes mentioned in from 8 to 48 seconds, and will materially increase the accuracy of the final product. While essentially a bench-type machine, the GCL-3" is usually furnished with a base which



Matthews Bomb-marking Machine



Bliss 250-ton Hydraulic Press

Equipment

contains an ample coolant system and an electrical control panel. It may also be furnished without the base, in which case it is necessary to supply a separate coolant system and electrical control panel. A battery of these small machines can be mounted on a long bench with one central coolant system.

A NEW universal ram-type turret lathe, the International Foster No. 5, with a collet-chuck capacity of 2 in. diameter and a swing of 17½ in. over the ways, has been announced by the International Machine Tool Corp., Foster Division, Elkhart, Ind. The machine is supplied complete with tools for both bar and chucking work, and will accommodate chucks of 8, 10 and 12 in. diam. In addition, it may be equipped with special attachments for specific types of turret-lathe work. These attachments include bar feed and collet chuck, taper attachment and threading attachment.

Improvements have been made recently in the 4 by 18-in. general purpose Foster superfinishing machine, and a new and longer (4 by 36-in.) model has been added to the company's line of machines. These general-purpose superfinishing machines are said to be capable of developing an extremely accurate and fine finish of 2-5 micro-inches on cylindrical work such as shafts used in aircraft engines, etc., where surface scratches and defects must be eliminated.

A line of four portable superfinishing attachments for cylindrical work also has been developed by the Foster Division. All are for use on the cross slides of engine lathes and turret lathes. They are said to be capable of develop-

ing an extremely accurate and fine surface finish (2 to 5 micro-inches) on a wide range of miscellaneous or production work. The only additional equipment necessary for performing superfinishing operations with these attachments is the stone lubricant supply, which consists of a small pump, reservoir and necessary piping. The different attachments are recommended for work in the following ranges: No. 0, up to ¾ in. diam.; No. 1, ¾ to 3 in. diam.; No. 2, 3 to 7 in. diam.; No. 3, over 7 in. diam. With all of the attachments the stone is applied to the work by spring pressure, and this pressure can be varied to suit the work in hand.

TRABON ENGINEERING CORP., Cleveland, Ohio, has brought out a Series H electric-hydraulic, barrel-type lubricant pump. These pumps are operated by plugging the extension cord into an electric outlet. Electric operation makes them well adapted for service alongside production lines for filling the bearings of various manufactured articles prior to their being shipped. The pump has advantages also for use by installation crews setting up machinery in new plants, and by maintenance men working Sundays and holidays. Under these conditions the compressed air needed for the operation of air-driven pumps usually is not available.

The pump, complete with motor, hydraulic cylinder, etc., is mounted rigidly on a flanged head. The flange fits snugly over a standard 55-gal., 400-lb. drum permitting oil, or light, medium or heavy grease to be pumped from the original shipping container without rehandling, and a lifting bail is provided permitting the unit to be transferred easily from one drum to another, with a hand hoist or lifting bar.

A NEW floor-type turret lathe recently announced by the South Bend Lathe Works, was specially designed for the rapid machining of small



South Bend 10-in. Turret Lathe

chucking or bar work. It can be used to advantage also for second-operation work. The lathe has a 10-in. swing over the bed or saddle ways, a 1½-in. hole through the headstock spindle, and a 1-in. collet capacity. It is equipped with both a compound-rest cross slide and a handlever cross slide, the two being interchangeable. The last mentioned is furnished with front and rear tool blocks which provide positions for three tools. A quick change gear box supplies 48 longitudinal power feeds

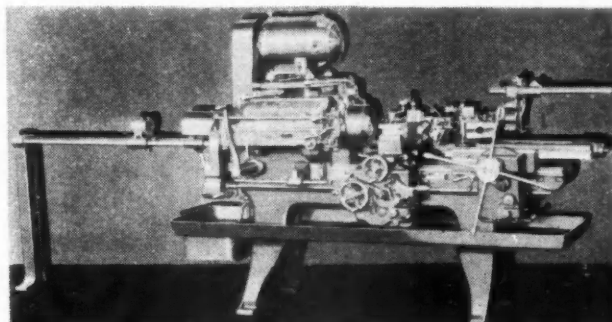


Trabon Series H Lubricant Pump



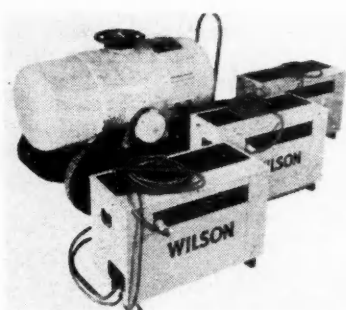
Red Ring GCL-3" Gear Finisher

International Foster No. 5 Turret Lathe



for the universal carriage, 48 power cross feeds for the compound rest cross slide, and 48 thread-cutting feeds, 4 to 224 per inch. The handlelever-operated bed turret indexes automatically and has a adjustable stop for each of the six turret tool positions. The underneath motor drive and back gears deliver twelve spindle speeds ranging from 50 to 1357 rpm.

GREATER welding output per machine, better control by the operator, and improved welds on thin-gage sheet are said to be obtainable through the use of the Honey Bee arc-control station recently developed by the Wilson Welder and Metals Co. of New York. These arc-control stations, which are an auxiliary electric device, are made in capacities of 75 and 150 amperes. They are connected in series with the welding circuit of any Constant-potential arc-welding generator. Most conventional

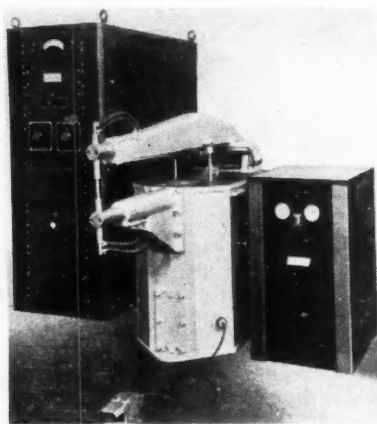


Honey Bee Arc-Control Station

drooping-voltage generators can be converted quickly and easily to constant potential. For this purpose, Wilson supplies a quick change switch mounted on the generator. A portable switch held in the operator's hand gives the operator remote control of the welding current within predetermined limits. This switch may be combined with the electrode holder, if desired. One advantage of these remote control devices is that when the operator reaches the end of a bead, he can reduce the current gradually, which in turn reduces the heat and avoids porous cracked craters and inclusions.

A NEW line of rocker-arm welders for stored-energy resistance welding has been announced by the Progressive Welder Company, Detroit. These welders are available with the Revers-O-Charge capacitor-discharge controls and "Frostrode" refrigerating units for "below-freezing" welding.

The new Progressive machine, designed especially for aluminum welding, has a retractable stroke of 9 to 12 in., depending on the throat depth. Retraction is accomplished by means of a lead screw driven by a fractional horsepower motor. The welding stroke has a range of up to 3 in. The rigidly-locked upper and lower sliding arms



Progressive Rocker-Arm Welder

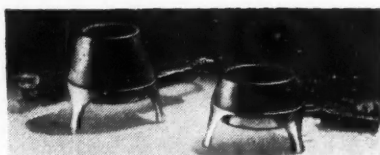
may be adjusted in and out for throat depth, or may be turned for angle mounting of electrodes when necessary.

Differential-action double air cylinders are used for the welding stroke, the cylinder for the return stroke being smaller than that for the pressure stroke. As a result, air pressure can be maintained continuously in the return-stroke cylinder, insuring prompt point opening after completion of the weld, and automatic discharge of the transformer secondary through a short-circuiting gun.

Point-dressing is accomplished by exhausting the return stroke of the air cylinder by means of a three-way hand valve conveniently located on the side of the machine, which allow the points to come together with just enough pressure to insure good point dressing.

SMALL capacity solder pots are being manufactured by Lectrohm, Inc., Cicero, Ill., for continuous operation in electrical-equipment and other plants where individual solder-melting pots are required for each operator. They consist of a cast-iron pot mounted on a plated-steel stand by a single screw. A single-heat, replaceable porcelain nickel-chrome heating element heats the pot. These pots are available in two sizes, of 1.75- and 2-lb capacity respectively, for operation on 110-volt a-c or d-c circuits. Each pot is equipped with a 6-ft. cord and attachment plug.

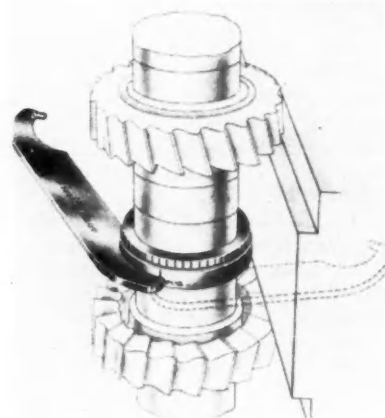
WITH the object of eliminating the necessity on the part of carbide-tool users, of designing special tools, as well as speeding the delivery of many "formerly special" tools, Carboly Company, Inc., has announced an extensive series of "design standards." These standards are intended to eliminate the



Lectrohm small capacity solder pots

loss of time usually sustained while preparing design drawings, figuring quotations, preparing working drawings, and hand-forming special samples. These new standards, while not being carried in stock, are the result of a study of orders for special tools received in connection with the production of war materials. Among the varieties of tools and blanks for which special design standards have been established are cut-off tools, roller-turner tools, grooving tools, shear-type tools, twist-drill tips, plug-gage and ring-gage bushings, drilljig bushings, guide rings, twist-drill stock, round, oval and half-round rod, rectangular rod, and tubing.

SPACING-COLLAR adjusting wrenches are now furnished as part of the equipment included with the micrometer-adjustable spacing collars for milling-machine cutter arbors of the Dayton-Rogers Manufacturing Co., Minneapolis, Minn. These new, double-end pin spanner wrenches make it possible for the operator to adjust the spacing collar to the desired thickness by loosening the cutter-arbor nut, being gov-



Spacing collar adjustment wrenches offered by Dayton-Rogers.

erned by the graduated micrometer sleeve when making the adjustment. The collar is then turned to the desired direction in accordance with marks engraved on the outer sleeve of the micrometer barrel.

A FLAME-HARDENING machine has been announced by Hydraulic Machinery, Inc., Detroit. As shown in the accompanying photo, the base and external housing are of welded steel. Hydraulic power and electric control are used, and all adjustments and parts that require routine maintenance are on the outside. The pilot light burners, and water coolant are located on the rear slide and are completely adjustable. Proper shielding directs the flame and the quenching water exactly where

(Turn to page 53, please)

Tanks, Guns, Combat Vehicles Now in Mass Production

**Automotive Industry Devoted 95.1 Per Cent of Effort
to War Work in July, According to Vaniman Report**

Automotive plants engaged in war work are rapidly reaching the mass production stage where tanks, guns and combat vehicles are beginning to come off the assembly lines with the continuity and the volume that marked passenger car and truck output in the pre-war era. The latest report from R. L. Vaniman, chief of the Automotive Branch of WPB, reveals that the automotive industry in July was devoting 95.1 per cent of its efforts to war work. This compares with 91.6 per cent on war work in June and 80.3 per cent in May, thus indicating that the job of conversion is nearly complete. Remaining civilian production in automotive plants is largely on functional replacement parts to keep the nation's essential transportation functioning during the war emergency. The Vaniman report was based on data gathered from 133 automotive companies operating 396 plants and comprising 68 per cent of the industry.

September shipments of war materials from automotive plants were estimated at \$512,000,000 by the Automotive Council for War Production, showing a 15 per cent gain over the \$445,000,000 worth of armament shipments in August. The September production pace translates into an annual rate of \$6,140,000,000 and this is expected to climb to an annual rate of \$8 billion by the end of 1942. Backlog

(Turn to page 46, please)

New OPA Plan of Tire Rationing

The five steps in the government's plan for keeping America's passenger cars rolling for essential mileage with a minimum use of rubber were announced Oct. 11 by price Administrator Leon Henderson. They are:

1. Rationing of used tires and recaps, and new tires now in stock to provide as far as possible the minimum essential mileage to each of the nation's passenger cars.

2. Actual control of each car's mileage through the rationing of gasoline to prevent unnecessary driving as far as possible, and to hold the national

average down to 5000 miles per car per year.

3. Compulsory periodic inspection of all tires to guard against abuse and to prevent wear beyond the point where they can be recapped.

(Turn to page 44, please)

Set Advertising Policy For War Plants

Advertising expenditures of corporations substantially engaged in the production of war materials will be deemed reasonable by governmental price adjustment agencies when reviewing overall corporate profits, provided such expenditures are ordinary, necessary and bear a reasonable relationship to the corporations' business activities. This policy, set forth in a joint statement by the Price Adjustment Boards of the War and Navy Departments and the Maritime Commission, is similar to that applied to certain other operating costs.

In considering the reasonableness of advertising expenditures, the statement explains, the agencies will follow a policy closely paralleling that which was recently announced by the Treasury Department as governing its methods of allowing income tax deductions on advertising costs.

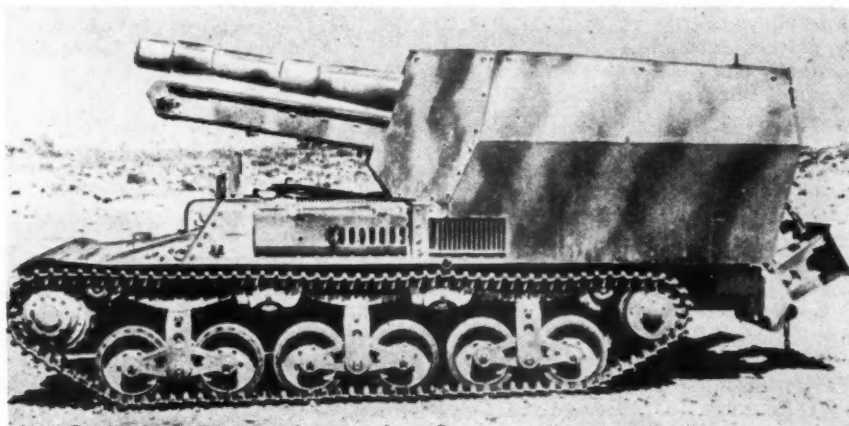
The three boards recognize that it may be necessary for producers to keep their names and the names of their peace-time products before the consuming public in order to maintain their good will and be in a position more effectively to regain their normal markets after the war is won.

The test of whether expenditures for advertising are deductible is whether they are ordinary and necessary and bear a reasonable relation to the business activities in which the enterprise is engaged. This is not intended to exclude institutional advertising.

Automotive Taxes Hit All-Time High

Automobile and truck owners of the United States have been paying 35 per cent more automotive taxes since the first of the year than during the same period last year, notwithstanding a sharp falling off in car usage, according to a report made public by the

(Turn to page 44, please)



Official British photo from Acmé

German Mobile Gun Captured on Desert

This is a 105mm mobile gun that was captured intact by the British in recent Western desert action against the Germans. The chassis was of French manufacture, possibly made in the Renault works, recently bombed by the RAF. It was quite new with only slightly less than 1,000 kilometers registered on the speedometer.

Government Names Replacement Parts Men

Among new subcommittees of the automotive replacement parts industry recently named by the government is the Chassis Parts Subcommittee, composed of E. A. Clark, vice-president of Budd Wheel Co., Detroit; William H. Courtright, Wm. & Harvey Rowland, Inc., Philadelphia; F. B. Willis, Bendix Products Division of Bendix Aviation Corp., South Bend, Ind.; J. D. Eby, vice-president of Wagner Electric Co., St. Louis, and F. A. Miller, U. S. Asbestos Division of Raybestos Manhattan Corp., Manheim, Pa.

The Anti-friction Bearings Subcommittee includes E. H. Austin, Timken Roller Bearing Co., Canton, Ohio; V. A. Dupy, United Motors Service, Inc., Detroit; L. R. Murphy, Roller Bearing Co. of America, Trenton, N. J., and J. H. Thorsell, Marlin Rockwell Co., Jamestown, N. Y.

The Material Requirements Subcommittee is composed of K. J. Ammerman, assistant to the president of Borg-Warner Corp., Chicago; B. B. Bachman, vice-president of the Autocar Co., Ardmore, Pa.; F. C. Bahr, vice-president



When Chrysler Got the Army-Navy "E"

Shown at the award of the Army-Navy "E" to seven Chrysler Corp. plants, Oct. 6, at Chrysler Highland Park plant, are, left to right: Capt. A. S. Wotherspoon, Inspector in Charge, Naval Ordnance Plant; Under-Secretary of the Navy, James V. Forrestal; K. T. Keller, president, Chrysler Corporation; Rr. Admiral W. H. P. Blandy, Chief of Ordnance, U. S. Navy.

and general manager of the Chrysler Motor Parts Corp., Detroit; V. E. Doonan, general sales executive of the Ford Motor Co., Dearborn, Mich.; M. D. Douglas, manager of the parts and accessories division of Chevrolet Motor Division of GM, Detroit, and A. L. Johnson, Warner Machine Products Co., Muncie, Ind.

ing on Sept. 15, 1942, unless such increase is necessary to correct maladjustments or inequalities, to eliminate substandards of living, to correct gross inequities or to aid in the effective prosecution of the war."

The correction of wage inequalities is likely to be a prime argument by the unions in an effort to circumvent the provisions of the economic stabilization order but the WLB decision in the Chrysler case may limit its effectiveness.

The monthly dues checkoff will be retained under the provisions of the revised contract between the UAW-CIO and the Ford Motor Co. which was approved recently by the union members. The company had opposed continuance of the checkoff. Wage issues in the dispute have been left to the decision of the WLB. Features of the contract already approved call for improved grievance procedure, with a company labor relations man having authority to settle grievances to be placed in each unit or plant and all grievances to be acted upon within two weeks of presentation improved representation.

Chrysler Wage Increase Totals \$7,488,000 on an Annual Basis

War Labor Board Also Boosted Vacation Pay Allowance and Ordered No Discrimination in Women's Wage Rates

The War Labor Board followed the precedent set in the recent General Motors case by granting a wage increase of 4 cents per hour to 90,000 Chrysler Corp. workers. The increase will total \$7,488,000 on an annual basis. The wage increase is retroactive to June 1, when the wage agreement between Chrysler and the UAW-CIO expired. The board also increased the vacation pay allowance, boosting it to \$90 for employees with five years' or more seniority and \$45 for those with at least a year's seniority, effective in 1943. It also ordered that there be no discrimination in wage rates against women employees, with the principle of equal pay for comparable work.

On the union's demands for eliminating inequalities in wage rates, the board, in a significant opinion, written by Dr. George W. Taylor, that may set a precedent in future wage cases, defined "inequalities" to cover only abnormal differences in wage rates. Dr. Taylor wrote:

"Differences in rates are not necessarily inequalities in rates. On the contrary, wages paid in American industry are normally characterized by all sorts of differences created for many different reasons. Under any sound program for stabilizing wages in this time of war, it must be presumed that well-established differences in wages are not

inequalities. This approach was accepted by the board in considering the question of North-South differentials in the textile cases. One must not interpret the above stated presumption, however, as an indication that established differences in wages can never become inequalities. They may be subject to adjustment if they become inequalities which must be rectified in the interests of full production of war goods. The point is, however, that a showing of an inequality in wages requires much more than a showing of differences."

The WLB refused the UAW-CIO plea for elimination of differentials between plants as well as that for a \$1 per hour minimum wage. Two labor members of the board dissented on the 4-cent per hour wage raise and the pay equalization decision.

Leo Lamotte, director of the UAW-CIO Chrysler Dept., sent a telegram of protest to W. H. Davis, WLB chairman, charging that the board ignored the recommendations of its own three-man panel that all disputes over pay inequalities should be negotiated and arbitrated.

However, President Roosevelt's executive order of Oct. 3 to stabilize the cost of living does take cognizance of wage inequalities. Paragraph 2 under Title II states, "The WLB shall not approve any increase in the wage rates prevail-

Heads Aircraft Industrial Engineers

The recently formed Society of Aircraft Industrial Engineers announced election of Clayman C. Shafer, a senior industrial engineer of the methods and controls department at Vultee Aircraft's Southern California plant, to head the organization's first chapter, which embraces the entire Los Angeles area.

As president of the first chapter established, Shafer announced that his group, including industrial engineers of Douglas, Lockheed, Vega, North American, Northrop, and Interstate, propose forming a panel of consultants whose combined services will be available to warplane producers seeking closer alignment of their manufacturing systems with urgent demand for faster quality output.

Automotive War Plants Praised by Roosevelt

He Visited the Chrysler Tank Arsenal, Ford Willow Run, Allis-Chalmers, Boeing, Douglas and Consolidated Works

President Roosevelt, who visited three automotive and four aircraft plants on his recent coast-to-coast secret inspection tour of war activities, had much praise for the Chrysler Tank Arsenal on his return to Washington. He said he thought the tank arsenal was an amazing example of what can be done by labor and industry for the war effort through good organization, the right spirit and proper planning. He also cited favorably the recent change of models from the M-3 to the M-4 without losing a single hour's output. K. T. Keller, Chrysler president, conducted President and Mrs. Roosevelt and Nelson through the tank arsenal.

At the Ford Willow Run bomber plant, Roosevelt was greeted by Henry and Edsel Ford and Charles M. Sorensen, who accompanied the presidential party through the huge plant, which covers 85 acres. Roosevelt told reporters on his return that Willow Run was an example of the wisdom of starting war plants long before Pearl Harbor. He said that it was not yet in production but would be soon.

Roosevelt also visited the Allis-Chalmers Mfg. Co. at Milwaukee, the Boeing Aircraft Co. at Seattle, the Douglas Aircraft Co., Inc., bomber plant at Long Beach, Cal.; the Consolidated Aircraft Corp. plant at San Diego, Cal., and the Consolidated bomber plant at Fort Worth, Tex. At the Boeing plant the President saw a gigantic new bomber (presumably the B-29) that made the Flying Fortress look like a pigmy. The Chief Executive said the Consolidated plant at Fort Worth, which is getting parts from Detroit, is just getting into production and making only a fraction of the planes it will be turning out in a few months.

Hudson Motor Car Co. has announced that it is producing marine engines for landing and invasion boats for the U. S. Navy. These engines, of a size and design different from automotive engines, will be produced almost entirely on automotive machinery. The Hudson Invader engine is of a powerful type designed to drive heavy barges in all kinds of weather.

The deadly efficiency of the Bofors 40-mm. anti-aircraft gun which Chrysler Corp. is making was graphically told by James V. Forrestal, Undersecretary of the Navy, at ceremonies in Detroit marking the award of the Army-Navy "E" to seven Chrysler plants.

"I know what these guns will do," said Forrestal, just back from a 20,000-mile tour of the Southwest Pacific war area. "Their work in the Solomons helped to dispel any ideas we may have had on the super-human bravery of the

Japs. A curtain of fire knocked down 14 Jap craft within a few minutes. These guns have taught our enemies a respect for our weapons."

Organize Powdered Metals Institute

All companies in the United States manufacturing parts from powdered metal have joined together to form the "Powdered Metals Institute," with headquarters in Saginaw, Mich., it has been announced by A. J. Langhammer, president of the Oilite Division of Chrysler Corp.

"The purpose of the Powdered Metals Institute is to serve as an advisory council and aid to the United States Army and Navy in regard to adapting powdered metal to war production because of the great savings in time, materials and cost which its use can bring about," Mr. Langhammer stated.

The officers of this new institute are as follows: Chairman, L. E. Field, vice president of the U. S. Graphite Co., Saginaw, Mich.; vice chairman, A. J. Langhammer, president of the Oilite Division of Chrysler, and Secretary, E. S. Patch, sales manager of the Moraine Products, a division of General Motors in Dayton, Ohio.

The following companies are members of the Powdered Metals Institute: United States Graphite Co., Saginaw, Mich.; Bound Brook Oilless Bearing Co., Bound Brook, N. J.; Chrysler Corp., Amplex Division, Detroit; Moraine Products Div., General Motors Corp., Dayton; Johnson Bronze Co., Newcastle, Pa.; Stackpole Carbone Co., St. Marys, Pa.; Keystone Carbon Co., St. Marys; Henry Crowley, Inc., West Orange, N. J.; P. R. Mallory and Co., Indianapolis; General Laminated Corp., New York City; Powder Metallurgy, Inc., Long Island City, and American Sintel Corp., Yonkers, New York.

Staggered Hours Ordered in N. J.

New Jersey became on October 6, the first State in the Nation in which a staggered hours program was ordered officially by Governmental authority. The Office of Defense Transportation viewed the action as the possible forerunner of similar steps by other Commonwealths and municipalities throughout the country in order to meet the transportation crisis.

The New Jersey staggered hours program was drawn up by the New Jersey War Transportation Committee,

appointed by Governor Charles Edison several months ago at the request of Joseph B. Eastman, ODT Director. Subsequently, Governor Edison appointed Joseph E. Conlon, President of the State Board of Utility Commissioners, State Coordinator of Transportation, with full war-time authority to coordinate public transportation facilities in line with the recommendations of the War Transportation Committee.

As his first official act, Mr. Conlon issued three directives:

Directive No. 1 ordered public schools, parochial schools, and high schools in cities throughout the State to adopt opening and closing hours in conformance with a schedule drawn up by the War Transportation Committee. In general, the school hours ordered were one hour later than those which previously had prevailed.

Directive No. 2 ordered all retail businesses in the business district of Newark not to open their doors to the public for the start of the day's business between the hours of 8 A. M. and 10 A. M., and not to close their doors to the public between the hours of 4 P. M. and 6 P. M.

Directive No. 3 ordered six companies employing large office forces to change the opening and closing hours of their offices to approximately an hour later than usual so as not to coincide with change of shifts at war plants.

Clark Moves Branches

Clark Equipment Co. has moved its Chicago branch office to 1412 Strauss Bldg., 310 S. Michigan Ave. The Detroit office also has been moved to 2211 Fisher Bldg.

CALENDAR

Conventions and Meetings

American Society of Tool Engineers, War Production Conference, Springfield, Mass.	Oct. 16-17
Automotive Advertisers Council, Chicago	Oct. 19-21
SAE National Fuels & Lubricants Mtg., Tulsa	Oct. 22-23
Assoc. of American Battery Manufacturers Annual Convention, Chicago, Oct. 22-23	
Natl. Lubricating Grease Inst., New Orleans, Annual Mtg.	Oct. 25-29
Natl. Safety Congress and Exposition, Chicago	Oct. 27-29
Natl. Safety Council, Chicago, Annual Mtg.	Oct. 27-29
American Petroleum Inst., Annual Mtg., Chicago	Nov. 9-13
Natl. Industrial Chemical Conf. & Exposition, Chicago	Nov. 17-22
Natl. Chemical Exposition, Chicago, Nov. 24-29	
Amer. Society of Mechanical Engrs., New York City, Annual Mtg.	Nov. 30-Dec. 4
Highway Research Board, St. Louis, Mo.	Dec. 2-4
SAE Air-Cargo Engineering Mtg., Chicago	Dec. 8-9
SAE War Production-Engineering Mtg., Detroit	Jan. 11-15

Engineers Need More Data, Less Censorship

Less strict censorship of the results of scientific research is urged in the annual report of the Welding Research Committee of the Engineering Foundation.

The committee's voice against censorship was raised by Colonel G. F. Jenks, president of the American Welding Society and chairman of the committee's Industrial Research Division. He said, "The division is beginning to feel the results of restrictions in the publication of information because of Government censorship."

"It believes that the greatest benefits to war production and to victory in the field will result from a liberal policy through which the results of research will be disseminated immediately to American engineers and scientists."

New OPA Plan

(Continued from page 41)

4. Denial of gasoline and tire replacements to cars whose drivers persistently violate the national 35-mile-an-hour speed limit for rubber conservation.

5. Capacity use, through car-sharing, of every car on every trip so far as possible.

The government's undertaking to keep tires on all passenger cars with driving reduced to essential mileage, Mr. Henderson said, is a goal which can be reached only if driving is brought within the 5000 mile a year average recommended by the Baruch report, and if there is strict adherence to the 35 mile an hour speed limit. Any failure to accomplish the mileage limit or speed cut will result in stricter curtailments to prevent excessive drain on the national rubber resources, he said.

Under the tire plan, Mr. Henderson said, replacements will be authorized for passenger cars on the basis of the minimum grade of tire that will serve for the mileage granted in the gasoline ration book. Those who use their cars but little will get certificates for recaps, or if their worn tires cannot be recapped, they will get used tires. Others will get recaps or new tires of the various grades now in dealers' stocks. But always, the minimum amount of rubber will be issued to meet the individual need.

To Represent Blanchard

The Blanchard Machine Co., Cambridge, Mass., has appointed the Rudel Machinery Co., Inc., with offices in New York City and Hartford, as representative for the eastern part of New York State, Northern New Jersey and the entire State of Connecticut. This territory formerly belonged to Henry Prentiss & Company who have retired from selling machine tools.

Training of Women Workers in Automotive Plants Emphasized

They Are Needed to Replace Men Drafted into the Army; Enlistments Created Acute Problem in Aircraft Industry

Larger manufacturing companies in the automotive industry have not yet felt the effects of the selective service act and voluntary enlistments to any great extent, but with the larger draft quotas being called for in the next few months, a shortage of labor in certain production centers is imminent. This shortage has been evident for some time in skilled classifications such as tool and die makers, but it is only beginning to be experienced among general production workers who do not require a long training period.

Six-month deferments have been granted essential workers whose indispensability has been vouched for by the management, but with the larger draft quotas being demanded, selective service boards are becoming less inclined to grant deferments. Their new attitude is expressed by Brig-Gen. Lewis B. Hershey, who states that if the Army can train a bomber pilot in eight months, industry should be able to break in all the production workers it needs in six months.

General Motors Corp. now has 24,046

of its former employees in the armed forces, having lost 2300 men to the services in September alone. Ford Motor Co., which has sent 11,230 workers into the services, saw 1629 don uniforms in September compared to 1170 in August. The new Willow Run bomber plant lost 585 men. The Chrysler Corp. has sent 7746 employees into the armed forces from its various plants, workers now joining up at the rate of 156 per week. The number going will be increased when Congress lowers the draft age.

The aircraft companies on the Pacific Coast have had an acute manpower problem in recent months, probably due to the fact that the personnel of those plants contains a larger proportion of young men than the longer-established automotive industry. Five major airframe manufacturers in southern California lost more than 3600 workers to the armed forces in August, and 77 per cent of these were voluntary enlistments. Finally, the War Department ordered that no more aircraft workers would be taken as enlistees unless cleared by their selective serve boards.

Automotive Taxes High

(Continued from page 41)

National Automobile Dealers Association today.

"United States Internal Revenue Collections from automotive sources for the first eight months of the current year were augmented by more than \$200,000,000 revenue from the two automobile use taxes," says the report. "Automobile parts and accessories, up 99.8 percent from last year, accounted for an additional \$10,000,000 increase. Income from new trucks was up 31.3 percent while the tax returns from transporting oil by pipelines increased 5 percent and on lubricating oil, 3.5 percent. Net increase for the eight month period were 35 percent greater than for the same months of 1941.

"Decreasing use of automobiles was shown by a 6 percent drop in revenue from the Federal gasoline tax, which accounted for only \$226,682,000 in the 1942 period as compared with \$241,100,000 in 1941. Income from taxes on tires and inner tubes dropped 48.2 percent due to the suspension of tire production for civilian uses.

"The greatest drop in Federal income," the report continues, "came as the result of the complete stoppage of passenger car production early in 1942. Income from this source was off 62.2 percent, dropping from \$69,742,000 in the first eight months of 1941 to \$26,670,000 in the same months of 1942.

"Federal revenue from all automotive

sources for the eight-month period this year reached an all-time high of \$547,919,000, an increase of \$141,964,000 or 35 percent over receipts of \$405,955,000 for the same months last year."

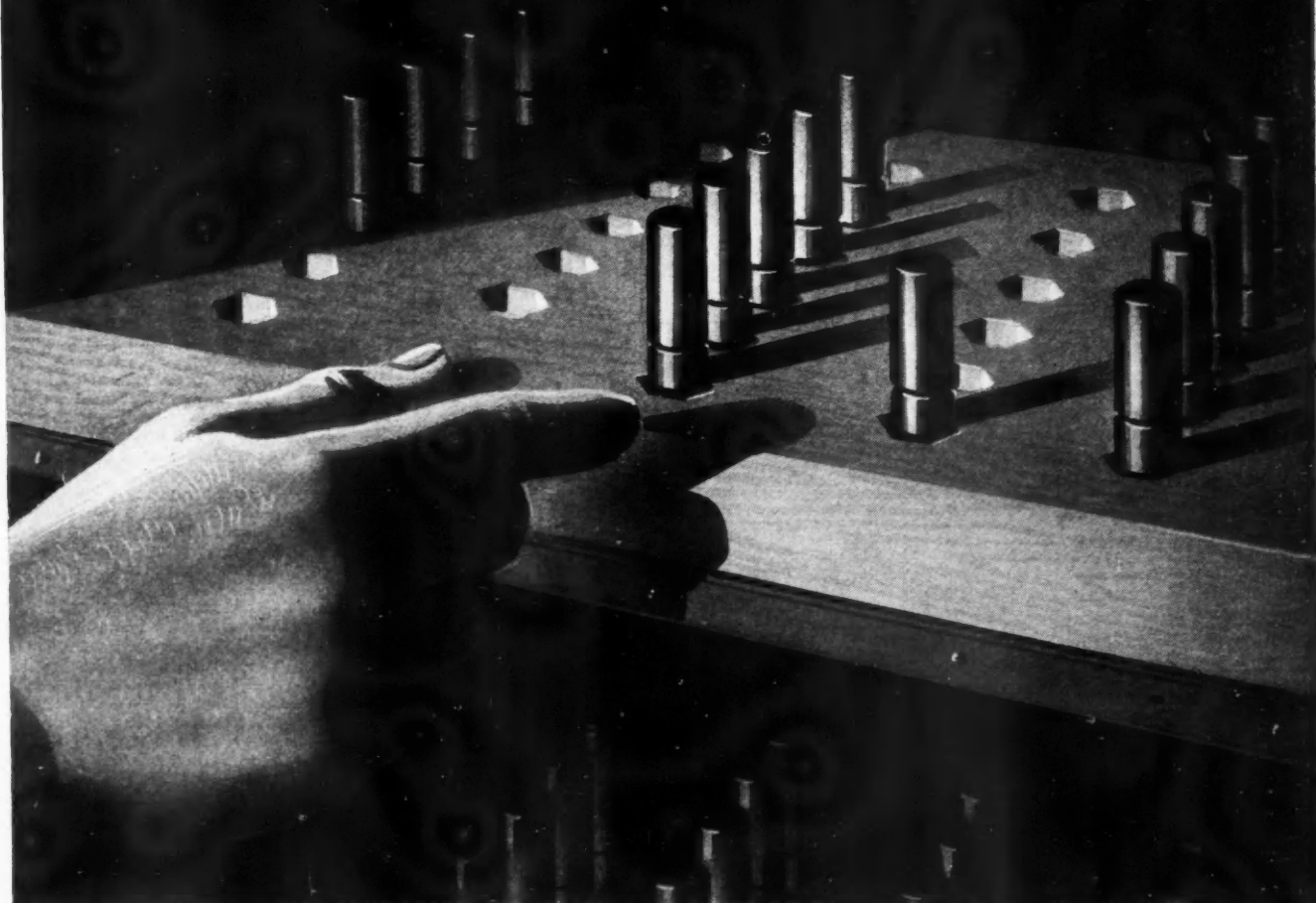
Distribution Plans Discussed with WPB

Automobile manufacturers conferred on Oct. 10 with Ferdinand Eberstadt, WPB vice chairman, on program determination and urged adoption of the material scheduling plan for the distribution of material. This plan follows the plan submitted to WPB by General Motors in midsummer. However, it is only a vertical rationing plan so far as major war contract holders and their sub-suppliers are concerned. This would account for approximately 75 per cent of all materials. PRP, under this plan, would be the medium by which 25 per cent of all materials would be distributed. In the latter category would be included bearings, bolts, nuts, rivets and other small manufactures stocked in anticipation of demand.

Clarence C. Cheadle

Clarence C. Cheadle, 61, associated with the public relations department of the Ford Motor Co. since 1924, died Oct. 6 at his home in Dearborn.

Life extension for plug gauges



Information supplied by "Automotive & Aviation Industries"

Plug gauges can justifiably be considered expendable — within limits. The time is bound to come when they become inaccurate because of wear. At that point the gauges were customarily scrapped.

Nowadays, new gauges for replacement purposes are hard to get. Therefore the method of extending their useful life adopted in one plant, as the result of a worker's suggestion, is of considerable interest.

The method is based on the fact that, when a gauge is worn enough to be undersize for one diameter hole,

it may be only slightly oversize for other diameters.

Consequently, worn plug gauges are graded according to size, and kept in a special rack. Then, when a gauge is needed for a particular diameter, a worn plug that is slightly oversize is taken from the rack and ground and lapped to plus or minus zero of the diameter required.

Of course, the life extension provided for gauges by this system cannot be accurately estimated. But it does amount to enough to make it well worth while.

CLIMAX FURNISHES AUTHORITATIVE ENGINEERING DATA ON MOLYBDENUM APPLICATIONS. MOLYBDIC OXIDE—BRIQUETTED OR CANNED • FERROMOLYBDENUM • "CALCIUM MOLYBDATE"

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Two Navy Men Win \$13,700 Lincoln Award

Captain C. A. Trexel and A. Amirkian, Director of Planning and Design, and Design Engineer, respectively, Bureau of Yards and Docks, Navy Department, Washington, D. C., were the winners of the \$13,700 grand award in the nationwide 2½-year \$200,000 scientific welding study program sponsored by the James F. Lincoln Arc Welding Foundation, Cleveland, Ohio.

The welding study brought forth reports of welding progress prepared by executives, engineers, designers, architects, production officials and others throughout the industrial field. The study indicated a possibility of tremendous savings in costs and man hours for production of products by arc welding for both war and peace.

Tanks, Guns Now In Mass Production

(Continued from page 41)

of war orders held by automotive companies with prime contracts as of Aug. 1 is estimated at more than \$10 billion by the Automotive Branch of WPB. This is made up of \$8,300,000,000 held by automobile companies, \$1,300,000,000 by truck companies and \$1 billion by parts companies. It is estimated that the backlog would require 26 months to fill at the July production rate. But the monthly rate is constantly increasing.

General Motors Corp., which has been continually boosting its armament shipments, delivered \$205,667,029 worth of war materials during August. This marked a 31 per cent increase over July shipments of \$156,892,348 from U. S. and Canadian plants, the largest gain registered in any month this year. The previous top was a 19 per cent increase in June deliveries over May. This indicates that GM is rapidly getting into volume production on many of its war contracts, such as tanks, guns, shells, marine engines and other armaments. Gm deliveries of war materials in the first eight months of 1942 totaled \$990,998,529. With only a nominal rate of increase for the last four months of 1942, war shipments for the year will exceed the \$2 billion mark, which surpasses GM net sales in every previous year except 1941, when the total was \$2,436,800,977.

Munitions output of all U. S. industry in August registered an 8 per cent gain over the July total, according to the monthly report by Donald M. Nelson, chairman of WPB. Total value of all munitions output plus war construction for August was \$4,700,000,000. The rate of gain was less than in any of the three previous months and lagged 14 per cent below the forecast for August. The WPB Munitions Index reached 357 in August, 27 points above the July figure and compared to a base index of 100 for November, 1941, prior to Pearl Harbor.

August aircraft production was up 6 per cent from July. Trainer plane output increased more than 25 per cent in August but the gain in combat plane production was insufficient and some types of service planes fell behind July production. Heavy bombers increased fairly well in August and another class of bomber also made a good record for the month, one plant which ran behind schedule in July doubling its output in August.

Ordnance production registered a 3 per cent gain in August. Output of light tanks has increased regularly for the past three months and the program is proceeding satisfactorily. Medium tank production has been retarded by a changeover from the M-3 to the M-4 but the proportion of M-4s being turned out increased very considerably in the month. August output of guns showed gains, self-propelled artillery was up and there was an improved showing in the total of scout cars and personnel carriers. The automotive industry is producing virtually all of these latter items.

Machine tool production in August totaled \$117,400,000, a gain of 3.3 per cent over July. This brought total machine tool output for the first eight months of 1942 to \$819,100,000 compared to \$771,400,000 for the entire year 1941. August output represented a peak annual rate of about \$1,400,000,000 while the peak annual rate to be achieved is expected to be \$1,600,000,000.



Herbert E. Smith, formerly vice-president, has been elected president of U. S. Rubber Co. He also has been elected chairman of the executive committee and a member of the finance committee. **Francis B. Davis, Jr.**, former president, continues as board chairman and chief executive officer.

Raymond J. Fitness, former manager of the automotive department of Willys-Overland, Inc., has been named operating manager, succeeding **Vera R. Drum**, resigned.

William Dubusker, formerly general superintendent of the Republic Aviation Corp. Indiana plant, has been appointed factory manager. **George Koehler**, former final assembly supervisor at the Farmingdale, L. I., plant, has been named general superintendent of the Indiana plant. **Barnett Means**, former final assembly foreman at Farmingdale, has been named parts plant superintendent of the Indiana plant.

Alfred R. Glancy, chief of the new Automotive Combat Center of the Ordnance Dept. at Detroit and a one-time vice-president of General Motors, has been advanced from colonel to brigadier-general.

F. M. Hoeffer, formerly vice-president and general manager, has been elected president of the Harvill Aircraft Die Casting Corp., succeeding **H. L. Harvill**, who retired in July. **Warren Stratton**, company attorney, has been elected a director.

Arthur B. Lawrence, of F. S. Smithers & Co., New York brokerage firm, has been elected a director of Hayes Industries, Inc.

Russell G. Davis was elected vice-president of Foote Bros. Gear and Machine Corp. at a recent meeting of the Board of Directors. He will continue in his capacity of general manager of the Industrial Gear Division.

A. J. Miller, who has been in the Detroit

Business in Brief

Written by the Guaranty Trust Co.,
New York. Exclusively for AUTO-
MOTIVE AND AVIATION INDUSTRIES

Narrow fluctuations of general business activity continue. The seasonally adjusted index of *The New York Times* for the week ended September 26 declined one point to 130.2 per cent of the estimated normal, as compared with 127.3 a year ago. The index of *The Journal of Commerce*, without seasonal adjustment, for the same period rose to 129.5 per cent of the 1927-29 average, a new war-time peak, as against 128.8 for the preceding week and 127.8 a year ago.

Department store sales during each week of the fortnight ended September 26, as reported by the Federal Reserve Board, were 5 per cent above comparable levels last year; and for the four weeks then ended sales averaged 8 per cent more than the corresponding amount a year earlier.

Railway freight loadings during the week ended September 26 totaled 897,714 cars, 0.6 per cent less than the number for the week before and 2.4 per cent below that for the comparable period last year.

Electric power output declined contra-seasonally in the week ended October 3, but was 10.6 per cent greater than a year ago, as against a similar excess of 13.7 per cent a week earlier.

Crude oil production during the same period averaged 3,684,500 barrels daily, 224,550 barrels below the figure for the preceding week and 381,700 barrels less than the average output recommended by the Office of the Petroleum Coordinator.

Average daily production of bituminous coal during the week ended September 26 was 1,883,000 tons, unchanged from the week before, as compared with 1,825,000 tons a year ago.

Engineering construction contracts awarded in the week ended October 1 again exceeded \$200,000,000, according to *Engineering News-Record*. For 1942 to date, the total is 58 per cent greater than the corresponding amount in 1941—with public work 85 per cent higher than a year ago, as against a drop of 51 per cent in private contracts.

Professor Fisher's index of wholesale commodity prices for the week ended October 2 rose to 108.2 per cent of the 1926 average from 107.8 for the preceding week, as against 98.8 a year ago.

Member bank reserves declined \$294,000,000 during the final week of September, and estimated excess reserves dropped \$340,000,000 to a total of \$1,690,000,000. Business loans of reporting members declined \$11,000,000 in the same period and stood \$177,000,000 below the total a year earlier.

office of the Norton Co. for a number of years, has been appointed field engineer for that territory.

Robert C. Sessions has been appointed chief engineer of The Brown Fintube Co., Elyria, Ohio. He was formerly associated with the firm of Sessions and Sessions, Cleveland, Ohio.

Simmonds Aerocessories, Inc., has announced the appointment of **John W. Overbeke** as chief engineer.

The American Welding and Mfg. Co., Warren, Ohio, announces the appointment of **William J. Sampson, Jr.**, as president. He was formerly general manager of sales for the steel and Tube Div., Republic Steel Corp.

On the engine's
"firing line"

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Steel Output Up 4 Per Cent In First 9 Months of 1942

Big Improvement in Allotment of Semi-finished Steel; Scrap Drive and New Furnace Program Brighten Picture

By W. C. HIRSCH

Steel production continues at a consistently high rate. According to the American Iron & Steel Institute, output in the third quarter of the year aggregated 21,449,359 tons. This shows a virtually unchanged performance from the preceding quarter when the output was 21,538,358 tons. In the third quarter of 1941, most of which period preceded the outbreak of the war, production amounted to 20,621,474 tons, so that a gain of 4 per cent was recorded in this year's corresponding period.

It isn't alone in point of total tonnage, however, that progress is seen. With all of the fault-finding emanating from this or that war materials plant that delays in steel shipments continue to act as a brake on finished products deliveries, the over-all picture indicates marked improvement in the allotment of semi-finished steel to the various classes of rolled steel. Very little is heard these days of the paucity in the supply of steel plates, a topic that earlier this year was on everyone's lips.

Further plans for the reform of the Production Requirements Plan and the Allocation Classification System are reported to be under consideration, but these contemplated changes are more likely to be refinements of steel distribution control than a major change

in the program and set-up. Rigidity of regulation methods was long ago found unsuited to any phase of the war program, and flexibility, so that unforeseen developments can be provided for without the need of overhauling the entire system, recognized as the goal.

Neither the action of the International Tin Committee, which at its London meeting fixed production quotas at 105 per cent of standard tonnages (a rate being exceeded in all the areas from which tin is still obtainable), nor a release of the Combined Raw Materials Board issued through the Office of War Information, shed much new light on the tin situation. The Combined Raw Material Board document is noteworthy, however, because it states that the Texas City smelter will be able to produce at the rate of 52,000 tons a year by the end of 1942.

The need of restricting the use of copper to the highest preference ratings is pointed out in a review by H. O. King, chief of WPB's Copper Branch, who estimates requirements to be 25 per cent higher than the maximum supply now in sight. Copper Recovery Corp., acting for the Government's Metals Reserve Co., is striving to ameliorate this deficiency by buying up stocks of unused copper and brass and even of fabricated products and diverting this material to use in essential war work.

Airplane Manufacturers Pool Resources

(Continued from page 15)

the president. On October 12 the first full meeting of the council was held at the Glenn L. Martin plant in Baltimore with about 65 representatives of the member companies in attendance. Arrangements were made to transfer a surplus of standard machine tools of the Curtiss-Wright Corp. to the Brewster Aeronautical Corp., which had a deficit of such equipment. Under normal procedure it would require about 10 months for the Brewster company to obtain them while under the present setup they will be on hand in less than 30 days, it was explained. Seven committees have been named to cover production, materiel, engineering and standards, industrial relations, public relations, plant defense and coordination of service activities in the field. The next regular meeting on the third Monday in November will be held at the Republic Aviation Corp.

The Aircraft War Production Council was organized in April with a membership of eight Southern California

companies comprising Consolidated, Vultee, Lockheed, North American, Northrop, Vega, Ryan and Douglas. Boeing executives in Seattle maintain a close liaison with the council. Representatives of the respective companies on the board of directors are: Harry Woodhead, as president of Consolidated and chairman of the Vultee board represents those companies; Robert E. Gross, Lockheed president; J. H. Kindelberger, North American president; LaMotte T. Cohu, Northrop board chairman; Courtlandt Gross, Vega president; T. Claude Ryan, president of Ryan; and Donald W. Douglas, president of the Douglas company.

Other company representatives affiliated with the board comprise I. M. Laddon, vice president and works manager, Consolidated; A. M. Rochlen, director of industrial and public relations, Douglas; Cyril Chappallet, vice president and secretary, Lockheed; J. L. Atwood, vice president and general manager, North American; T. C. Coleman, vice president, Northrop; and T. C. Sullivan, secretary, Vultee. A council ruling provides for a change of president every six months, so at the end of September Mr. Douglas' terms

as president of the council expired and Mr. Woodhead, vice president, succeeded him to that office. Robert E. Gross was elected council vice president.

The West Coast council has committees functioning in the fields of production, materiel, engineering and standards, transportation and housing, accounting, plant defense, industrial and public relations, and industrial training.

A liaison is planned between the two councils and also with the Automotive Council for War Production, and the various Government and industrial agencies.

CENSORED

An exclusive feature prepared by
M. W. BOURDON, special correspondent of AUTOMOTIVE and AVIATION INDUSTRIES in Great Britain.

The Minister of Transport has announced that, as was the case last year, supplies of anti-freeze during the coming winter will be restricted to military vehicles, buses and trucks engaged on essential war work, although consideration will be given to doctors and similar users compelled to use their cars without notice at all hours of the day or night.

Morris Motors report for 1941, just issued, shows a trading profit of £2,224,087 against £1,951,164 for 1940. The next profit also shows an increase i.e. to £1,026,140 from £746,631. The improvement was due largely to the capacity of the company's plants being more fully utilized; during the early part of 1940 they had not been completely reorganized and reequipped for war work.

The Ministry of Supply has made it an offense to destroy, throw away or abandon waste rubber in any form. It must not be put in a refuse bin or mixed with other waste materials. The Ministry has also announced that supplies of new or reconditioned tires for trucks and buses will be dependent in future upon the availability of reclaimed rubber; for this reason, operators are told that, in their own interests, they should exert themselves to the utmost to salvage scrap rubber and induce other people to follow suit.

The Colloidal Research Laboratories Co., specializing in fluorescent lighting systems, has introduced a "forgery-proof" pass to prevent unauthorized entry into manufacturing plants during the black-out. It is a badge or button coated with an invisible transparent lacquer which glows when brought within the field of a "black" light from a source adjacent to the pass examiner. It is claimed that, unlike other known fluorescent materials, the special lacquer used for the "Glo-pass" glows immediately and ceases to glow as soon as it is withdrawn from the beam of the black light. Where several shifts are worked, each shift can be supplied with a pass of different color, so that if an employee enters with his shift and tries to leave immediately with the outgoing shift he will be detected at once.

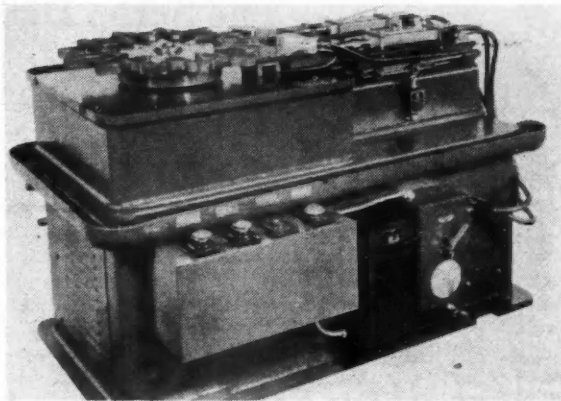
The annual census of road traffic in parts of England has been taken this year by school children, owing to the lack of adults to serve as enumerators. The census period was reduced from seven to three days, but the usual full day recording from 6 a.m. to 10 p.m. was retained. Boys and girls, between the ages of 14 and 16, were used.

Women are taking the place of the police in Edinburgh to control traffic at crossings used by children going to or returning from school.

New Production Equipment

(Continued from page 40)

required. The working parts are said to be adequately shielded against heat. Water is used as the quenching medium, and is completely sealed from the actuating mechanism. The work to be hardened is placed on the index table by hand, the pilot is positioned with a locating pin, and when the starting button is pushed the machine goes automatically through its complete cycle, stopping for unloading by hand.



Flame-hardening machine built by Hydraulic Machinery, Inc.

MACHINERY MANUFACTURING CO., Los Angeles, Calif., announces the new Vernon universal tool and cutter grinder which will handle all kinds of tools, cutters, cylindrical work, and internal jobs within its capacity limit. The chief specifications of the grinder are as follows:

- Swing of centers over table, 10½ in.
- Maximum longitudinal travel, 17¼ in.
- Max. work length between right and left-hand tailstocks, 16 in.
- Max. work length between headstock and tailstock, 13½ in.
- Max. distance between centerlines of work and wheel spindle, 10 in.
- Transverse travel of column, 7½ in.
- Vertical movement of wheel spindle, 6 in.



Vernon universal tool cutter and grinder.

The spindle head is powered by a ½-hp, 60-cycle, three-phase, ball-bearing motor running at 3450 rpm.

The Los Angeles company also is making a new milling head with integral motor drive and speed reducer especially designed for the Vernon No. 0 milling machine.

The head is rigidly supported on the overarm and may be reversed, using the motor on either side.

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The Scrap Drive

(Continued from page 10)

lowered tax bills on physical properties.

Ninety plants of the General Motors Corp. yielded 265,500 tons of iron, steel, copper, aluminum and other metal scrap in the first seven months of 1942. Of this total, 250,000 tons were iron and steel scrap and the rest non-ferrous metals. In June and July alone, 12,559 tons of dormant scrap were shipped from GM plants in addition to the regular flow of production scrap. Incomplete reports from 24 divisions revealed 22,287 tons of dormant scrap uncovered in seven months. An analysis of dies

held for replacement parts resulted in a shipment of 319,830 lb. of dies.

A virtual "iron mine" was found beside a railroad siding in one GM plant where cast iron borings had been dumped for years. Intensive salvage of rags, papers and boxes permitted a GM plant in Ohio to dismantle its incinerator, resulting in 26,000 lb. of scrap. Another plant found 1800 tools in its tool "morgue" that had not been used for five years. These were scrapped and now the plant is studying tools for which there has been no demand in two

years. Old railroad spurs have been torn up. Unused steam pipes and wiring have been removed from abandoned utility tunnels. A machine gun plant found its grinder sludge contained 95-per cent ferrous metal and received permission from the steel mills to ship the sludge with the other scrap. Steel, lead and copper alloy is recovered from the sand used to stop the bullets on the proof firing range, bringing recovery of 20,000 lb. of material in the initial operation. Scrap materials are segregated in the GM plants so that an alloy of one type is not mixed with metal composed of another alloy. All GM tools, equipment and dies are being re-appraised, with the slogan of "Do you really need it" as the decisive factor.

Ford Motor Co. has 700 men working on salvage operations alone at the Rouge plant, which has its own steel mill that requires scrap iron to feed it. Material conservation is so far advanced that oil waste is skimmed off the surface of the River Rouge and used to lay dust on miles of roads at the Rouge plant. Hudson Motor Car Co. has collected 2825 tons of iron and steel scrap and 281 tons of aluminum scrap in the four months of the salvage drive. Studebaker Corp. moved 578 tons of dormant equipment out in 17 carloads of scrap to two Ohio steel mills in a single week last June.

Recently queried as to what should be done with highly specialized automobile manufacturing machinery that has been packed away in grease for the duration, Donald M. Nelson, chief of WPB, replied, "In my opinion it ought to be used for scrap or parts taken off of it for maintenance and repair of other machinery." Nelson then reiterated the policy laid down by Lessing Rosenwald, chief of the Conservation Division of WPB, who said that machinery not used in the past three months and not to be used in the coming three months should be scrapped. Much automotive machinery that cannot be converted to the war effort, such as huge presses for body sections and fenders as well as the dies for these non-functional parts, comes in this category. The Government must decide whether all the potential postwar production tied up in these dies and machines should be sacrificed in order to provide the additional tons of scrap metal that are vitally needed in war production. However, this means that new dies, tools and machines have to be built after the war for the post-war models instead of resuming on 1942 model production, the period of reconversion may be extended from six to 12 months instead of the three to six months that might elapse if the factories retained their 1942 dies and productive facilities. The employment of 300,000 to 400,000 production workers over a six-month period may rest on the Government's decision. The automobile industry is hopeful that 1942 model dies and machines will be scrapped only as a last resort—after other salvage sources have dried up.

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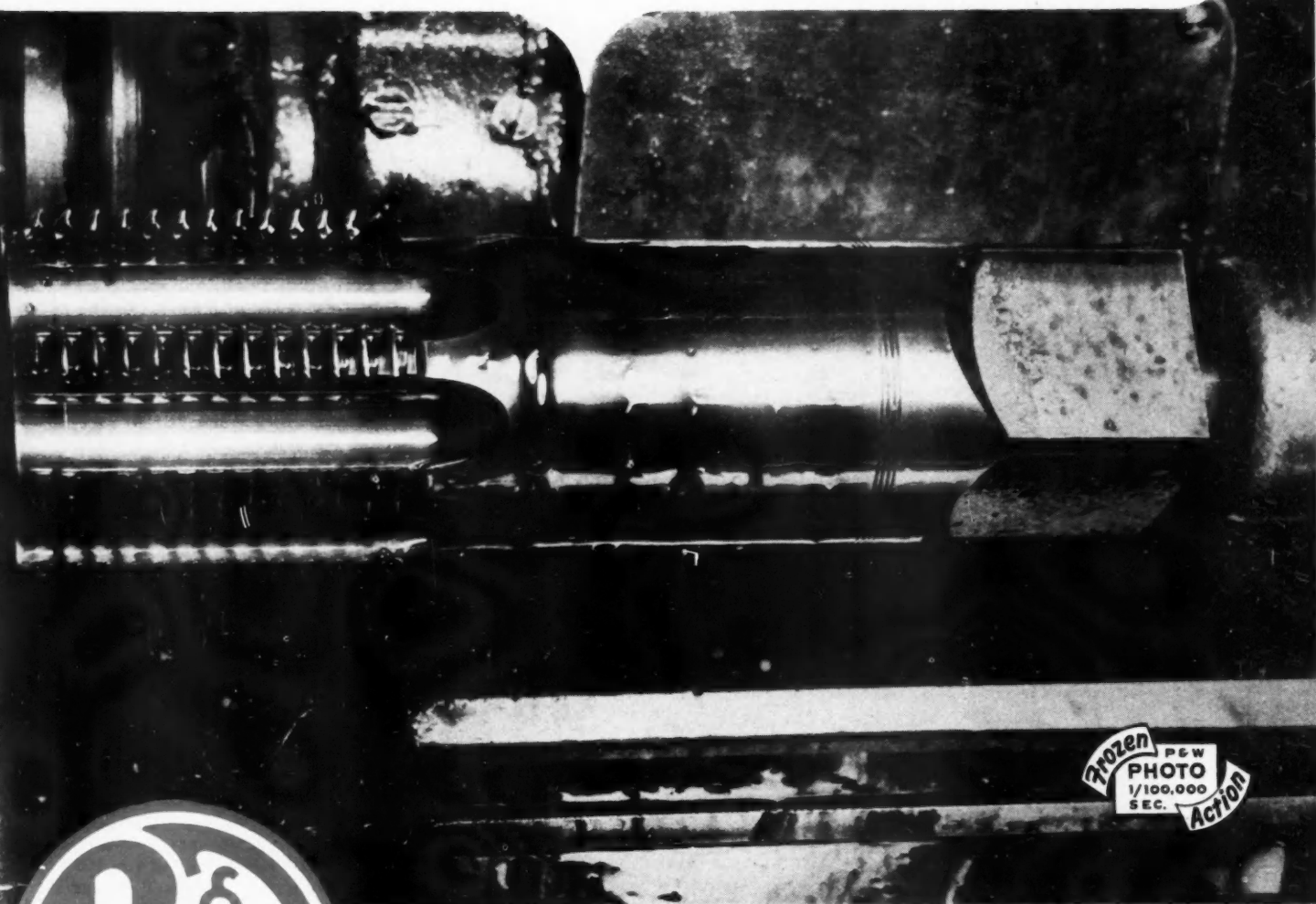
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Division Niles-Bement-Pond Company

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SAE Aircraft Production Meeting

(Continued from page 14)

the Wright and the Pratt-Whitney. (An abstract of this paper was published in the July 1 issue of AUTOMOTIVE AND AVIATION INDUSTRIES.)

The second morning session was devoted to aircraft welding, and was ably conducted by Peter Altman, SAE Aircraft vice-president and director of manufacturing research, Vultee Aircraft, Detroit. Why spot welding is not used as much in aircraft manufacture as in other industries fabricating sheet

metal was explained by G. R. Mikhala-pov, National Research Council, in his paper, "The Place and Use of Spot Welding in Design and Production of Aircraft." He also illustrated and described the extent to which spot welding is used at present, and pointed out particular requirements of spot welded design.

The steps being taken by the air-frame manufacturers in their efforts to conserve critical materials were de-

scribed by L. D. Bonham, Lockheed Aircraft Corp. at the Airframes Production Technique session under the chairmanship of J. M. Gwinn, Jr., Consolidated Aircraft. A paper, "Template Duplication by Dry Offset Printing," by W. A. Collings and J. T. Barnes, Curtiss-Wright Corp., discussed the development of the process using a reproduction proof-press for printing duplicate templates directly on template stock. The principle feature which distinguishes this method from other methods is the provision of a means of jig-drilling duplicate templates by the use of the original template as a drill jig. Duplicates produced by this method are completely ready, after filing, for actual use in the plant. R. C. Blaylock, of the Curtiss-Wright Columbus plant, read the paper.

Two papers were read on the important subject of aircraft materials. Painting, finishing, construction, and glue qualities in mass production of wood aircraft were dealt with in a paper by C. L. Bates and H. J. Black of Plxweve Mfg. Co., "New Applications of Panelyte in the Aircraft Industry" were discussed by C. R. Mahaney, general manager, Panelyte Division, St. Regis Paper Co. He described the substitution for critical metals of Panelyte structural plastic in flooring and skin to replace aluminum sheet, and in aircraft engine parts, various molded parts and precision fabricated parts.

Boeing Production System

(Continued from page 19)

bility of Boeing's scheme of production, changes can be made in a minimum of time, and without affecting the speed of production schedules. The prime example of this fluid system in operation was the changeover from the Boeing B-17E to the B-17F.

Production density requires that floor space be utilized to the best possible advantage. Wing jigs, for example, customarily have been set up parallel with the floor. A series of such jigs would require an astonishing amount of floor space, so Boeing built them skyscraper fashion, putting up a battery of jigs vertical to the floor. One battery, capable of producing several wings, occupies a space equivalent to two horizontal wing jigs.

Chip Handling

(Continued from page 11)

Whirled at 780 rpm, these chips lose the last traces of oil which spin off to drain and be reclaimed. The oil-free chips drop into another belt conveyor which hoists them into a 100-ton storage hopper, 40 ft over a spur track on which railroad gondola cars await loading. The mouth of an oversize chute is opened and a metal flood of 25 tons pours into the railroad gondola, ready for shipment to a processing plant.



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